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AVIATION CALENDAR

(Continued from page 5)

Telluride, Pa. Spencer National Science Foundation, Office of Naval Research, Air Force Office of Scientific Research/Nuclear Physics Division (This location of conferences proceedings is as reported.)

March 30-31 Western Metal Exposition and Congress, American Society for Metals, Pico Pacific Auditorium and Ambassador Hotel, Los Angeles, Calif.

March 31-2 April 1 Testing Conference, American Rocket Society, Dartmouth Plaza Hotel, Danbury, Conn., Pa.

March 31-26 National Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

March 31-27-30th Annual Conference, Pacific Coast Section of the Society of the Plastics Industry, Hotel del Coronado, San Diego, Calif.

March 31-Apr. 2-Fabrication Institute of Brooklyn's Ninth International Symposium Subject: Materials War, Anderson Engineering Society Bldg., New York, N. Y.

March 31-Apr. 3-National Aeronautics Meeting, Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

Apr. 1-3-Continuation on Electricity by Global Wire sponsored by the Thermal Radiation Laboratory of the General Research Directorate of the Air Force, Cambridge Research Center, Somers Hotel, Somers, N.Y.

Apr. 1-18-1954 National Congress, Municipal Auditorium, Cleveland, Ohio. For information, Engineers Joint Council, 29 West Third St., New York 13, N. Y.

Apr. 7-18-1954 Wildlife Show and 4th Annual Convention, American Wildlife Society, International Amphitheatre and Hotel Marmon, Chicago, Ill.

Apr. 12-14-Forces Arm's World Congress of Flight, Las Vegas, Nev.

Apr. 18-22-Lateral Vibration, American Society of Tool Engineers, Schenck Hotel, Milwaukee, Wis.

Apr. 21-22-Aviation Technical Conference on Electronics, Radio Frequency Commission Section of the Institute of Radio Engineers, Engineering Society Bldg., Cincinnati, Ohio.

Apr. 22-24-1954 Annual Meeting, Institute of Environmental Engineers, Radio City Hotel, Chicago, Ill.

Apr. 29-May 1-Combinable Facilities Conference, American Rocket Society, Villach, Illinois, Institute of Technology, Chicago, Ill.

May 4-6-National Aeronautical Electronics Conference, Institute of Radio Engineers, Schenck Hotel, Dallas, Texas.

May 4-7-1954 Visual Flight Test Symposium, sponsored by the Instrument Society of America, Seattle Rhythm, Chicago Hotel, North Washington, D. C.

May 4-7-Spring Meeting, International Scientific Radio Union, Willard Hotel, Washington, D. C.

May 6-6-December Regional Conference and Trade Show, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

June 12-21-Third French International Air Show, Le Bourget, Paris, France.

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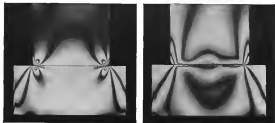
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ROLLER BEARING LIFE AND CAPACITY LINKED TO STRESS DISTRIBUTION



These reproductions of photostatic studies contain important evidence for every engineer and designer concerned with the performance and selection of roller bearings. In these photographs, the elaborate study and light waves, called isopics, indicate not only the magnitude of stress but also the stress distribution. The photographs were taken by Bower Research Engineers during a study of stress distribution in roller bearings.

The subjects represent rollers and raceways of two roller bearings under identical loads. The illustration at the left shows a roller of conventional design. The illustration at the right shows a Bower "Profiled" roller. That is, the roller is precision ground with a large radius generated along the body of the roller—a predetermined and controlled distance from each end.

The conventional roller photo (left) clearly shows how, under load, stress concentrates both up and near the

roller ends. This is called edge loading. Both areas of concentrated stress are the breeding grounds for metal fatigue and eventual bearing failure.

In the photo of the "Profiled" roller (right) stress lines can be seen uniformly distributed stress for the whole length of the roller and raceway. There are no points of excessive stress concentration, consequently no starting points for early fatigue. Such a "Profiled" roller confers a great advantage in increased load carrying capacity, a most important bearing requirement.

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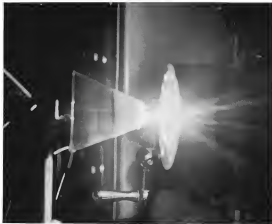
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REPORTS CONTINUOUSLY

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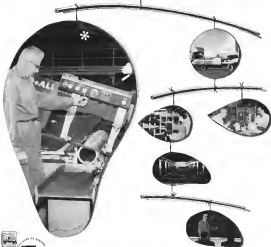
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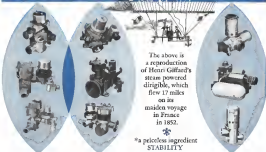
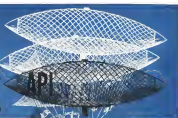
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EDITORIAL

Rewards and Responsibility

The airline pilots have been remarkably successful in their battle to gain for themselves what they consider their proper reward for their work in the jet transport era. Ten pay for jet airline captains in commercial airline service is \$15,000 while, for similar duties in domestic service, a maximum of \$25,000 is attainable. According to C. L. Soren, president of the Air Line Pilots Assn., the average annual wage of all airline pilots even before the jet pay bonus was \$12,000. A total of 600 airline pilots earned \$20,000 or more before the jet pay. The pilots also have been remarkably successful in establishing their professional position in the jet cockpit to their satisfaction.

With these rewards under their belt, we respectfully suggest that the pilots give some serious thought and earnest effort to fully discharging their responsibilities to their management and the traveling public that has so eagerly taken to the jet age. We are extremely worried, therefore, to the pilots' point of view and his maintenance problems. We came into aviation via the cockpit and spent sufficient time in both military and civil operations to understand how all of the often elements of a nation's expansion, weather conditions, federal laws, flight surgeon, dispatchers, etc.—apparently, involved in a vast and continuous conspiracy to unnecessarily complicate operations in the cockpit.

We also have bought hard evidence for many of the safety devices and procedures, such as radar, high speed on approach lights, modernized airway systems and navigation aids, that the pilots have felt necessary to their improved operations.

But there have been indications recently that some airline pilots are willing to accept the rewards of their work without fully discharging all of their responsibilities. Let us cite a few of these more warnings that already have appeared on the air safety horizon.

Most recent is the case of the Pan American Boeing 707 jet transport that peeled off into a spiral fall from 35,000 ft. with 114 passengers aboard and exploded in Miami beach and inland areas thus, to us, making a tremendous success at 4,000 ft. above the Atlantic. The full report on this incident has not yet been made. But it is already evident that a too casual approach by the pilots in the cockpit of operating this aircraft were contributing causes. It is already apparent that all of the safety warnings involved in prevent an accident of this sort operated properly but were not heeded by the pilots until small errors were compounded into a near miss. Pan American's ruling that two pilots must always in their seats with belts fastened and oxygen masks on is a recognition of the problem involved in fully discharging a jet transport pilot's responsibilities.

The recent spot check by the Civil Aeronautics Administration on the instrument capabilities of Northwest Air Lines' pilots (AWG ET 27, p. 58) is another case in point. The results of this check was truly shocking. One pilot had only the foggiest notion of how to execute various traffic control procedures. Another experienced extreme difficulty in operating a DC-6B on instruments and at least one was found to be too deficient in instrument capability to continue line operations without further training.

We also recommend a thorough reading of the Civil Aeronautics Board report on the Boeing DC-7C crash near the Miami airport (AWG Feb 6, p. 10) for another indication of how a too casual attitude toward small errors, warnings of impending trouble and a questionable go/no-go decision, in the cockpit can be compounded into tragedy.

Another point we believe pertinent to this discussion is the growing tendency of airline pilots to see their large blocks of leisure time to operate other commercial enterprises. Now 50 to 60 months is certainly not long to spend at an occupation that yields up to \$40,000 annually. But to operate these 50 monthly hours in the safely and efficiently requires the full time professional attention of the men involved. Their job should begin long before the jet, up to 10 flight operations to plan a particular flight. This problem of maintaining full professional proficiency is even more acute with the advent of the jet age.

A man who accepts the lucrative rewards of operating high speed, high altitude, high-density seating jet transport even his passengers and his management has full professional attention he beyond the 50 monthly hours in the air and the maximum profit planning time.

We seriously question whether this degree of professional concentration and efficiency can be maintained by men who are operating insurance agencies, real estate deals, wholesale businesses or any of the other varied commercial enterprises that have become a standard item of so many airline pilots' ground time.

The question of pilot age and physical standards is bound to become more acute with the jet age. There must be some more satisfactory method of combining the rich experience that only accrues to the 30 years with the mental alertness and quick reflexes required for safe and efficient jet operations than the rigid screening system now supported by the Air Line Pilots Assn. We hope that the new Federal Aviation Agency will fully explore this problem as a high priority project.

Although the airline pilots have taken a major step in approach to solving their working problems, they are still as integral part of the airline management structure and a vital part of the management's success or failure. We think that some airline management and some segments of the Pilots Assn. are missing an opportunity in not fully exploring this relationship. The pilot is perhaps the most important point of contact between the airline and its fare paying customer. We have all seen many accidents of how a pilot who recognizes that he is a serious-minded professional for his airline and his "customers" who operate as though their own planes were filled with cattle instead of human beings drive their passengers to fly under some other flag. And, of course, the most substantial contribution the pilots can make to passenger revenue is a perfect safety record.

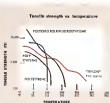
The advent of the jet age has imposed new standards of efficiency and responsibilities on the airline pilot. Airline management has seen that rewards at least commensurate to the tasks imposed. If the pilots find it fully discharge their responsibilities under these new standards, airplanes will be bent and people kept, and saving the pilot.

—Robert Hutz



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In the Front Office

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Paul K. Jewett, Jr., executive vice president; Vito Giannini, Jr., assistant; New York, N. Y., and William B. Hill, a vice president.

Paul E. Smith, president, Fisher Sub Corp., Colton, Calif., a division of Fisher Aircraft Corp., Cleveland, Ohio. Also Scott A. Rogers, vice president; T. J. McGeehan, vice president.

Mid Continental Aerospace Corp., Kansas City, Mo., new subsidiary of Pacific Aerospace Corp., Bakersfield, Calif., has appointed the following: Howard A. Smith, president; Ray Rudenberg, vice president; C. K. Koser, secretary-treasurer; Also James H. Staker, Denver, Colo., branch manager; and Ralph H. Galloway, Chicago, Ill., branch manager.

Lee Paul, first vice president, LAY, The Vancouver, British Columbia.

G. E. Lake, vice president-traffic and sales, Chicago Helicopter Airways, Inc.

Dr. O. G. Hayward, corporate group vice president-military products and industrial equipment, P. H. Hays & Son, Hunt Station Station, N. Y.

Howard F. Ray, vice president, Aerial Enterprises, Inc., New York, N. Y.

William W. Keck, vice president-general manager, The R. F. Goodrich Co., Akron, Ohio.

T. K. Lynch, vice president-sales and marketing, Dynast Corp., Gwynedd, Pa.

Edward J. O'Neill, vice president-general manager, Magnetics Applications, Inc., New York, N. Y.

The Federal Aviation Agency, Washington, D. C., has announced the following appointments: George E. Rouse, Chief, Jet Propulsion Division, Southern California; and John G. Fink, Chief, Jet Propulsion Division, Southern California.

Reg. Gen. Ernest F. Rostenberg has been named commander of the Army Aviation Center and Fort Rucker, Ala., replacing the late Maj. Gen. Richard S. Cline.

Honors and Elections

Dr. William E. Fehring and Dr. James A. Van Allen have received the American Society of Aeronautics and Astronautics Distinguished Achievement Award. Dr. Fehring, Director of Jet Propulsion Laboratory, was cited for his outstanding leadership and leadership contributions to the Agency's mission in the advanced space program and space fields. Dr. Van Allen, Chairman of the Division of Space Sciences, was cited for his exceptional contributions to the conception, planning and execution of the scientific research program of the U. S. International Geophysical Year Program.

Dr. Don E. Armstrong, manager of Aerojet-General Corp.'s Chemical Division, has been elected chairman of the Southern California section of the American Chemical Society.

(Continued on page 122)

INDUSTRY OBSERVER

Air Force and Army sub-baltic missile projects are considering the feasibility of placing a cloud of sand across the path of an incoming weapon. Sand would destroy vehicles by rapid erosion, friction and penetration. Army's Weapons Electric Division, Palo Alto, would determine a nuclear method to neutralize enemy weapons by neutron pollution.

General Electric has developed a new technique that will enable its ground-based turbine engine sub-assembly production system to automatically grade a number of variables. Feasibility of GE system is quite near those of one made at a time was one of major factors behind Air Force decision last summer to substitute American Buntz Ames inverted guidance on later models of the Atlas. New technique may cause Air Force to re-evaluate its ballistic missile guidance plans.

Fundamentally different technique for determining direction of earth's vertical from a vehicle operating within the earth's atmosphere, which does not use gravity sensing element in the vehicle, is being investigated by Collins Radio Co., Chesham, Ill. If proven successful, would eliminate effect of vehicle acceleration which introduces errors in present gyro that use gravity sensing device. Program is being sponsored by Wright Air Development Center's Flight Control Laboratory.

Project Saturn is the designation of a new Army orbital space program now under development by the Army Ballistic Missile Agency, Powerplant manufacturing in North American Aviation Inc.

Major reduction in cost of producing titanium is expected to result from a new semiconductor fabrication technique developed by Westinghouse Electric under Wright Air Development Center sponsorship. Official announcement is expected this spring.

Pratt & Whitney J55 turboprop developed for Navy may be used in follow-on version of the Northrop X-45 sub-orbital carrier aircraft. About 10 of the high-thrust turboprop probably already have been built under the Navy program.

Concrete-designed fuel utilization system for precision metering of propellant for Atlas ICBM has substantially exceeded performance expectations in a number of successive test firings of the missile from Cape Canaveral, Fla.

Boeing's Division is building a new space station projected for installation and testing in 1960's by the Hughes HRS-3 helicopter, which would house some equipment used to test from a layer or from the surface in tests area. Some gain is expected to cover three to four times the area possible with present equipment.

Fuel cell which now is able to convert gasoline and air directly into electricity with extremely high overall conversion efficiency of between 55 and 65% is being developed by General Electric under Army sponsorship. The design—basically, a hydrogen-oxygen fuel cell employing a catalyst to convert gasoline into hydrogen—may prove valuable in a space-vehicle powerplant.

Air Force is considering use of Army Ordnance facilities for more production and assembly of the Minuteman sub-orbital ICBM as a more to expedite work and test costs. Ordnance units in the nearest would get the equipment under the plan.

Swiveling of jet engine engine controls pitch and yaw, but still is controlled by simple moving turbine gas vent to rotate of an actuator. Flexible metal vent pipe, which also is about like a wing cable, is replacing swiveling like vent that appeared on records and development models.

Low line is building a three-axis stability augmentation system for Northrop's X-36 Tiltrotor. First flight of Tiltrotor may be made before the end of the month.



HOW THE SILICONES MAN HELPED... BREATHE MORE LIFE INTO AN OXYGEN MASK

Aboard the new jetliners, oxygen masks are standard emergency equipment. If air pressure in the cabin drops, passengers and crew members can quickly breathe oxygen from a piped system.

Based on experiments by the military, manufacturers knew that silicone rubber is the ideal material for oxygen face masks. It provides the thin, elastic shapes needed to fit all facial contours... with a gentle lubricity that leaks pleasant to the skin. Silicone rubber is highly resistant to oxidation, ozone attack and extremes of

temperature. It can be stored for long periods and take repeated hot-water cleaning. And, any color is available—even "emergency" yellow.

This jet-age application demonstrates several useful properties of UNION CARBIDE silicone rubber. Background information and technical data available by writing Dept. BA-9946, Silicones Division, Union Carbide Corporation, 30 East 42nd St., New York 17, N.Y. In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Toronto 7.

UNION CARBIDE SILICONES
1960-1970

Unveiling the secrets of silicones
Rubbers, Resins, Greases, Oils and Emulsions
The term "Union Carbide" is a registered trade mark of UCC.

Washington Roundup

Regrouping Air Defense

Watch for all air defense research and development to be shifted out of Air Force, Army and Navy and concentrated directly under the supervision of Dr. Herbert York, Defense Department director of research and engineering. Incomparable of an defense weapons system already developed and produced by the separate services with a single overall defense system, is the reason for the shift. MITRE, the aerospace technical advisory group from all three, Massachusetts Institute of Technology for technical monitoring of USAF Cambridge air defense system integration group, probably will continue to serve as Dr. York's technical supervisor in this area.

'Hordened' Bomarc Sites

Seeing Bomarc interceptor missile will shift from present static radar missile stations to a "hordened" concrete shelter for the longer ranged Bomarc II needed to provide greater resistance to enemy strategic attacks on the air defense system. New Bomarc shelter has present concrete slabs in halves of feet and with equipment to slide slabs back onto a steel frame leaving the missile open for firing.

Hawk: European Production

Public announcement of a project for European production of the Ames-Bitterton Hawk low-altitude air defense missile is expected shortly. It is understood the project will total about \$500 million. Countries participating include France, Italy, Germany, Belgium and the Netherlands. Discussions also are under way for possible European production of New York's Sparhawk anti-air missile. European production of a solid-propellant intermediate range ballistic missile, possibly the Matra Pring, also is being considered. Under Defense Department's "business assistance" program, the U.S. furnishes know-how and such items as machine tools, gages, dies, mechanical engineering drawings for the common production program.

Military Construction

Leon's share of this year's \$1.5 billion military construction program is for the Air Force. The program authorized to Congress last week for authorization is divided this way: USAF, \$885 million; Army, \$340 million; Navy, \$265 million. The largest individual projects are: Lemore, Calif., Naval Air Station, \$26.9 million; Ft. Meigs Pacific Missile Range, \$30 million; Andrews AFB, Md., \$21.4 million; Wright-Patterson AFB, \$21.5 million; Richard I. Bong, AFB, Wis., \$21.5 million.

CAB Refusal

Civil Aeronautics Board has refused to make additional comments on its Sept. 23 statement with respect to a jet wreckage on North Atlantic routes despite repeat requests from three U.S. airlines that a clarification of the statement is essential to a solution of the controversial wreckage issue. International Air Transport Association conference has considered in Paris this week in hopes of ironing out the problem. All three airlines pre-

stated that the Board's statement has been misinterpreted by foreign carriers and, according to Southeast and Western Airlines, a further clarification is needed to provide an "opportunity for a much needed compromise solution to the current IATA impasse."

Pan American World Airways, a strong opponent of the embargo, supported the Board's refusal to clarify upon its position and called the original statement "not only clear but sound." Pan American also noted that the CAB letter reported previous statements by the Board "to United States carrier members of IATA in the effect that... it favors upon equipment [air] deficiencies."

Railway Labor Act

In another area, informed observers believe the Railway Labor Act will remain virtually unchanged despite a great meeting called by the Department of Labor last week between union management and labor leaders. Reports from the closed-door session indicate that the Air Line Pilots Assn., Flight Engineers International Assn., and International Assn. of Mechanics remained solid in their opposition to industry-suggested changes in the act which call for a ban on jurisdictional work, a secret ballot on strike votes, time limit on industrial efforts and prohibition of secondary boycotts. It also was noted that American, Trans World, Continental and Trans Texas airlines joined with union leaders in opposing recommendations by Eastern and United unions urging a form of compulsory arbitration. Department of Labor spokesmen declined to confirm or deny the reports and observed that the meeting was closed to the press in the hope of "just expression" which showed that publicity of heated discussion at such meetings too often resulted in nothing being accomplished.

Higher Taxes

Meanwhile, Rep. John McCormack (D-Min.), House majority leader, has urged President Eisenhower to call for higher taxes if this is necessary to finance greater defense spending within a balanced budget. McCormack made comment that talk of his own and related spending by Administration officials has led to a "feeling of complacency" by the American public and a dangerous belief that there is "nothing to fear from the Soviets."

Defense Information

Rep. Carl Vinson (D-Ga.), chairman of the House Armed Services Committee, has told Secretary of Defense Neil McElroy that it would be illegal to place the information activities of the Joint Chiefs of Staff in the newsweeklies, making it clear that the new laws are not to be administered directly from the office of the Secretary.

During congressional testimony, McElroy had reported on a plan to place the command information activities under Secretary.

—Washington staff



MATING TITAN intercontinental ballistic missile is mated into position on its Cape Canaveral, Fla., launch pad by this crawler train, shown being lowered into horizontal position before actual firing. Power and instrumentation buses are connected to the missile from the umbilical tower at left. This view is an assembly line production at The Martin Co., Denver, Colo. ICBM plant.

Space Technology

Plans Detailed for Titan Complex Design

By J. S. Betz, Jr.

Wellington-Comptech bids will be opened Mar. 19 for the construction of the nation's first space-based nuclear ground missile base at Lowry AFB, Colo., to house the Martin Air Force Titan intercontinental ballistic missile.

Construction of the "backyard" nuclear missile and steel complex to house one squadron of Titans, with nine separate underground emplacements or "tubs" is scheduled to be completed 710 days after the award of a contract which probably will be made around April 1. Total of \$45 million already has been released by Air Force to get construction under way.

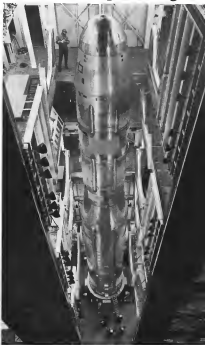
Requests for bids to handle the construction were made by the U. S. Army Corps of Engineers shortly before the first successful firing of a Titan test vehicle from Cape Canaveral, Fla., on Feb. 6. The development vehicle flew between 250 and 300 mi. in limited range tests.

Corps of Engineers also have asked for bids to construct additions to the training base facilities at Vandenberg AFB, Calif. That work includes three underground missile silos similar to the ones to be built at Lowry AFB. The waste intended for training purposes, these installations also will have operational capability if generated by trained troops.

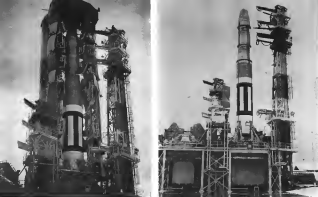
The first operational base at Lowry AFB consists presently of the following concrete and steel chambers:

- Nine operational silos 151 ft. deep and 46 ft. in diameter, with elevation to lift the missile to ground level for firing after transportation have been accomplished underground.
- Three portal (storage) silos 73 ft. deep and 27 ft. in diameter.
- Three storage silos of spherical shape with a 51 ft. radius and an inside height of 35 ft., 9 in. at the center.
- Three pressurization of spherical shape with a 62 ft. radius and an inside height of 46 ft. at the center.
- Nine support silos 62 ft. deep and 46 ft. in diameter.
- Nine propellant tanks 47 ft. deep and 57 1/2 ft. in diameter.
- Six exhaust tunnels 68 ft. deep and 27 ft. in diameter.

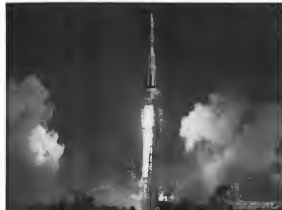
Two attempts to launch a Titan test vehicle consisting of a live first stage, a second stage loaded with water and a dummy warhead paralleled the recent successful firing. In each case, the missile had been retrieved on its pad and the first stage engine automatically shut down when trouble developed during



TITAN ICBM is moved by Johnston of Martin's central test laboratory at Denver, prior to shipment to Cape Canaveral. Titan is powered by an Aerojet-General liquid fueled rocket engine and has both radio-control and ejection seat systems.



DIRECTOR TOWER is a full vertical position at left. Launch stand allows two steps, so that first and second stages can be erected/telescoped separately (note two flame deflection at right). Reaction firing and checkout is done separately, electronic control of the ascent down and controlled flight is rigid so that second stage first at same point as separate that it would in actual flight.



a 6 ft sec. test firing period just prior to launch.

During this period the first stage engine builds to maximum thrust within about two seconds of separating properly, the remaining four seconds are used to check behavior of auxiliary systems.

Operational countdown and launching of a Titan will take place in the relative safety of a "hardened" underground facilities capable of withstanding war causes by thermobaric weapons, but it will not be automatically shorter than the launching time required by other liquid-fueled ICBMs. The time will be much longer than the FS time, was widely quoted as the warning time which will be available in the event of a sneak SCBM attack.

Checkout and maintenance of most of the Titan's systems can be accomplished in the inside sites as in the equipment terminals which are located 30 or 40 ft. away and connected with them by a tunnel. Each of the test firing sites has its own separate equipment and propellant terminals so that it can function independently during the preparation of the missile for firing. The sites are separated by several hundred feet of earth.

The firing sites are segmented into three sections of three each. A separate control center and ground guidance system is provided for each section. Last activity prior to launch that a crew, in this case before serving behind blast proof doors to prepare the missile for firing. The launching is handled automatically from the control center and, after this is completed, the 118 ton missile is moved to the surface. An auxiliary tower will be used at the same time to support the instrumentation and control leads needed during the final moments on the ground.

Ground Control

Antenna for the radio/telemetry guidance system will have to be used from their underground compartments, and they will enable the missile to be controlled from the ground until its radar action begins. It is possible that this type of guidance will be placed in the future by a completely self-contained system that does not require ground action after launching. The initial version also would allow all warhead reentry in a sequence to be launched simultaneously in a volley. With the radio command system, a separate antenna system is required to launch each missile. Six of these antenna systems are provided with each system under present planning. New developments in this field may change the picture, however and allow each ground guidance center with its antenna to guide more than one missile.

Two principal types of launch will be used to connect the various chambers

to the missiles, personnel and utility tunnels. The personnel tunnels will be smaller—about 10 ft in diameter—and constructed primarily of steel. Construction at Vandenberg Air Force Base which is now out for bid is similar in design to that for the experimental complex at Lowry AFB. It consists primarily of the following:

- Three operational-type sites, including the propellant loading system.
- Three equipment terminals.

Space Technology

House Unit Schedules Hearings To Probe U.S. Space 'Maze'

By Ford Entom

Washington—Defense Department officials will soon be called before the House Committee on Science and Astronautics and asked to unravel the U.S. military space effort's "tangled" organization and lines of authority, Rep. Orrin G. Brooks (D-La.) announced last week.

Decision to call Defense witnesses, including Secretary Neil H. McElroy, followed an explanation by Rep. Adam Clayton Powell (D-N.Y.), Assistant Chief of Naval Operations for Research and Development of the number of persons involved before any new proposal can be approved.

In response to questions by committee members, Adam Powell said that as at least 10 officials with authority to write or approve proposals. These, he said, include both officers who might not be technically qualified to write various considerations in the overall picture. Adam Powell added that such considerations are considerable delay before action can be taken in defense decisions on program and plans.

Adding to the confusion is the fact that the authorities are not yet fully understood, even before the Senate Committee on Astronautics and Space Sciences in New York. Brooks, director of the Office of Defense Research and Engineering and Rep. W. Johnson, director of Defense Department's Advanced Research Projects Agency.

Johnson testified that he has complete authority to discharge duties and administer funds appropriated by Congress for Defense Department projects in the field of space, military technology, ballistic missile defense and anti-propellant technology.

York and his authority calls for him to act as the principal advisor on technical matters to the Secretary of Defense, supervise all research and op-

- Three propellant terminals, including the propellant loading system.
- Two antenna sites.
- One control center.
- Antenna terminal and pad.
- Test and test bases and instrumentation.

But on the work will be spread on Mar. 4, and 500 days will be allowed for its completion after the awarding of contracts which should occur toward the end of March.

meeting in the Defense Department and direct and control such projects "deserved scrutiny of continued control by congressional committees."

Adam Powell said the House committee that he felt there should be such complete freedom given to charge of the overall space program to accelerate the effort and not increase time.

Another way to speed the space effort, Howard said, is to recruit a two-year budget task force research and development projects. This, he said, would accelerate the decision making process between, as a one-year term, estimates for the next year's budget must be submitted before it is known what has been necessary to carry projects in the current budget.

Watch Russia

Adam Powell also predicted the U.S. could reach Russia in the ballistic missile field within a year if greater effort is put in this area. He said that while the U.S. may be ahead of Russia "across the board," the country could be in serious trouble if the Soviet Union produces intercontinental ballistic missiles in quantity before the U.S. does.

Nike Zeus Thrust

Washington—Expend of \$5,000,000 has been directed for periods of time and small amounts during this test of the Nike Zeus missile program for the Nike Zeus missile system, according to Maj. Gen. William W. Dick, Jr., director of special weapons in the Office of the Chief of Army Research and Development. Gen. Dick said the House Committee on Science and Astronautics has said that the House has the propellant manufactured by Good Counsel Rocket Co. would be sufficient to launch a missile at the speed necessary to intercept an incoming ballistic missile.

North Central Mass-Schedules Traffic

By Robert H. Cook

Minneapolis—Philosophy behind the rise of North Central Airlines as a leader of the nation's 13 best-known airlines centers about President Hal N. Carr's perception of mass production flight schedules as a means of representing the transportation traffic system.

Operating over a route system with an average length of line of only 76 mi. and some as small as 25 mi., with high-speed low capacity Douglas DC-3s, the firm has represented a study in the use of the airbus in the past four years which earned the presidency.

Last year, the airline boarded 777,144 passengers for a 14% increase over 1957. Earnings on constant time flight schedules produced a 19% gain in revenue, more than doubling 31,208,865 in last year, and a 30% increase in revenue passenger miles at 117,573,651. Heavy gains also came from a 50% increase in mail, 302,311, up 14% over 1957, and an expense rate index, 806, 956, up 12% over the previous year.

At the same time, North Central's performance index of 10.25 remained one of the highest in the industry. Carr adds that the airline's on-schedule arrival record of 78.7% is "exceptional" in view of the often severe weather conditions prevailing over the carrier's route system.

Mass Scheduling

This year, North Central anticipates that it will carry one million passengers through utilization of its mass scheduling principle. Scheduling on easy aircraft will be expanded by the use of five Convair 440s now being delivered, and the airline is extending its route system to 1,497 mi., by the addition of 17 new cities included in the recent Route States Area Case. Carr



FLIGHTS of North Central's Convair 440s will be placed hour-to-hour while with the carrier's new jet offering. Hourly mass schedule would also be met. Douglas DC-3 operations will be placed in 12 hr. spans on the longer jet-timed of the harshest schedules.

and the airline will investigate service to 11 of the new points in North Dakota, South Dakota and Minnesota on Min. 1.

Carr explains his philosophy of making the most use of the carrier's fleet of 32 DC-3s, which have an average daily utilization rate of 7.3 hr., by saying that "they don't make money on the ground."

Prime example of the thinking he had in mind scheduling in the carrier's 28-mi. Minneapolis-Chicago segment in competition with Northwest and American Airlines. North Central provides 51 flights a day in this market area and claims 85% of the business.

When applied to low productive points, the mass scheduling policy has gradually increased load factors. North Central flight from Oakland Wis., formerly had to eight a day with an average of three passengers per flight, was increased to 15 a day selling in average payloads per flight of 51 passengers.

Service at Duluth, Minn., once had to eight daily flights carrying no passengers per flight, was increased to 28 flights a day producing 75 passengers per flight.

Carr says that while the mass scheduling principle should, and has paid significant dividends in general convenience on one in the area ahead. He adds that the need for mass and better flight service to smaller communities has been demonstrated by decreasing air service, de-centralization of routes to rural centers, and an attendant population growth which should have the combined effect of expanding North Central's traffic potential.

Today, the airline has flown 32 to 35,000 passengers a month and this approach's one million plane miles each month as compared with 300,000 in 1957. While this implies of volume will be expected to increase month after month and special problems. North Central's management has succeeded in cutting expenses to match even phase of operation. Five years ago, delays were averaging 60 a month as compared with only 21 last month. Average last year had factor stood at 45-47% last year with 33 unscheduled engine changes in 168,183 engine hours. Delay operating costs per plane mile were 12 cents. Living expenses cost 37.2 cents.

Higher Capacity

Use of the 40-passenger Convair will give the carrier better flight frequency and higher capacity. Part of the new aircraft has been delivered with the balance expected by late April. Initially, the aircraft will be used on high-density routes such as Duluth-Chicago nonstop route which last year produced a 60% load factor.

Carr points out that the DC-3 load factor was severely limited on this route by fuel load requirements. With its longer range, the Convair will have all seats available, and assuming it retains the same 60% load factor, Carr said the new plane should increase traffic by 50,000 passengers a year between the two cities.

Cost analysis studies on the Convair indicate that North Central may expect daily operating costs per plane mile of 94 cents. Direct costs of each should be 2.1 cents compared with 1.25 cents for the industry average for DC-3s.

craft. Passenger load factor needed to meet direct costs has been estimated at 29% in comparison with 14% for average DC-3 operations by low-density carriers.

Carr was in fact the Convair over the Lincoln, Ill. flying because of the carrier's higher unit capacity which he says may be increased in the future.

However, he is considering the possibility of converting the Convair to turboprops by adding Napier-Helm or Allison jets.

Nipart two in studies indicate a conversion cost of \$490,000 per plane, with the design cost estimated to increase the aircraft's cruise power by \$710,000 per unit based upon an increased block speed of 10 mph. 3,000

hr. efficiency and a revenue rate of six cents per seat mile in comparison with the Convair.

Purchased from Continental Airlines at a cost of \$2,140,000, including spare parts, the new planes are under option and purchased and will be fitted with radial engine units designed to reduce engine noise by 40%. Cost of the planes was included in a \$4,540,000 financing program completed last month by North Central.

The airline still hopes to secure Laidlaw Control Airline, although the plan was rejected by the Civil Aeronautics Board and the decision was upheld last month by the U. S. Court of Appeals for the District of Columbia. Airline for North Central has taken legal action to carry the case to the U. S. Supreme Court.

Senate Airport Aid Bill Proposes \$100 Million in Annual Spending

Washington—The Senate bill on air scheduling, S. 102, will have passed legislation authorizing \$400 million a year in federal airport aid over the next four years.

The House Commerce Committee stated hearings on the measure last week.

The Senate bill also provides a \$65 million "emergency" fund to get the expansion program under way immediately.

The \$405 million total is more than a third of the total \$1.29 billion that Federal Aviation Agency estimates will be required for airport financing over the four-year period—\$1,015 million for scheduled airports and \$270 million for general aviation projects. This would have a total \$425 million for local financing.

The President vetoed legislation authorizing \$400 million in federal airport aid—\$400 million a year for five years—after Congress adjourned last year (AW Sept. 6, p. 28).

The Administration's program provided a total \$700 million in federal airport aid over the next four years and a complete withdrawal of federal assistance at the end of that time based on support in the Senate (AW Feb. 2, p. 41).

Before Senate passage of the \$405 million measure, there were three schemes.

As a major concession to the Administration, the Democratic leadership reduced its program from five to four years and the authorization by \$110 million, from \$275 million. In addition, the \$300 million for the 1959 year, the majority of which was cut from \$75 million to \$65 million.

by allocation and a revenue rate of six cents per seat mile in comparison with the Convair.

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Schoepel (R-Kans.) to continue the present program of \$65 million in federal aid annually, for the next four years—or a total \$272 million authorization—was defeated 55 to 33.

As an amendment authorizing a total \$385 million federal aid over four years, offered by Sen. Thomas (R-Ill., R-1) was voted down, 37 to 40. This provided \$69.5 million a year, plus an emergency fund of 538 million. Mexico said he had been offered by RAA Administrator Elwood F. Gjerstad that he proposed authorized "all that can be prepared or obligated" and that "there is a reasonable chance" it would not be voted by the President.

•Morris by Sen. Norris (Calif., R-N.H.) to be federal aid for the construction of terminal buildings was defeated 33 to 57.

Under the Senate approach, however, 75% of the \$405 million, or \$303 million, would be allocated to the states and territories under a formula based on area and population. Allocations of one to \$16 million would go to California, \$27.3 million (Illinois, \$19.9 million, Michigan, \$10.5 million; New York, \$16.5 million; Pennsylvania, \$12 million; Texas, \$14.6 million). A total of \$160 million would be allocated at the discretion of the FAA Administrator.



Canadair 540 Makes First Flight

Initial passenger Canadair 540 turboprop transport makes its first flight at Montreal base of Canadian Ltd. Aircraft will be operated by Royal Canadian Air Force Transport Command (AW Feb. 2, p. 40). Second passenger flight, also for RCAR, is scheduled to make its first flight the first week in March. That will be used by Canadian for demonstration and other purposes. First flight of 140-ton weight also carried, lifted four hours, instead of, at gross weight of 40,874 lb., was less than 7,000 lb. Airframe is a new Canadair 440 converted by Canadair for installation of Napier-Helm turboprop engines. Royal Canadian Air Force ordered 30.



Hal N. Carr

TO CORPORATE OFFICERS AND CHIEF PILOTS

Quality, a word too often built up, is built into both the Gulfstream and its Rolls-Royce Dart engine. This modern aircraft, with fail-safe construction, typifies the reliability inherent in Grumman products for 25 years; while the engines have already been proved by millions of hours of airline operation. The achievements by these two leaders in their respective fields assure you of quality and safety in a true sense of the word.

The new Grumman Gulfstream, the optimum in executive transportation, features high air speed, pressurization and short field characteristics designed specifically to meet your corporate flying requirements.

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Initial Comet Operations Please BOAC

By Glenn Carriker

New York-British Overseas Airways Corp. says it has experienced 'virtually trouble-free' operations at its de Havilland Comet 4 on the North Atlantic, where daily New York-London service was inaugurated Nov. 14.

Only one pavement removal at a Roth-Bayer Area habitat region has been necessary, occasioned by entry of a squirrel which slightly damaged the inlet guide vane. No other untoward incidents have occurred with the Comet, according to BOMAC. Most delays on the transatlantic route have been due to weather, and most of the potential schedules have made it smoothly.

During the first two months of service, only five of 63 eastbound flights made stops, three at Gander and two at Shannon. Several of the nonstop flights, however, diverted to Penticton, Gatwick and Heeren because of London Airport weather conditions. Flight times of the nonstop that landed at London averaged 6 hr. 55 min. from the beginning of service through Jan. 15.

Time between overhauls of the Comet's engines is now around 1,800 hr.

BAEC flies the Comet 4 as a de luxe

and first class aircraft, and its load factor in both directions from Nov. 19 through Jan. 17 averaged 82%. This compares overall with load factors of 62% for the airline's transatlantic Bristol-Boston route the same period.

The Comets, of course, are not true transatlantic airplanes and will move to other routes when BOAC gets its big Boeing 707-420s and, later, its Airbus A300-600. Present aircraft are

position while waiting on the ground between flights. After unloading, the car towed off the gate to a nearby hard-surfaced parking area for unloading, and towed back again at departure time for loading. Only once has a Comet had to go to the hangar at Midfield, that time for repair of a wing ball track link.

Anti-Hepatitis B surface antigen

Port of New York Authority intramural runway restrictions at the airport have had no effect on the Connet's parcel in performance to date, although they could cause a fight to be delayed overnight. The Connet, with a full load gross takeoff weight of about 157,500 lb., doesn't have the same runway length problems as the Boeing 707-320.

But jet fights during nighttime hours must use the preferred runway, and a cross wind component could that runs out, the jet wouldn't be able to take off until morning. The hasn't happened so far with the Comet's 9 a.m. departure.

Coastal (1) had requirement for a immediate carbonaceous sorbent is about 68,380 lb. on the average, RCNC says. On the cost: it burns about 7,078 lb. of limestone an hour at an average free stream of 400 ft

strong effect at Midway. On some occasions air traffic control limitations or military use of high-altitude airspace have precluded this technique, which is ideal for a jet. But generally the flights are planned with a beginning cruise altitude of 33,000 ft and about 39,000 ft, so far from altitude of the cruise.

A flight-planning problem for BOAC is a transatlantic jet operator has been in getting sufficient timely and accurate reports on wind and temperature data, but the airline says this situation has been improving.

In flight planning in tomorrow's Comet, BONG is able to use a drift climb procedure most of the time, according to Andrew Mistry, flight oper-

In handling its Coast on the ramp, BONE has established several personnel procedures against blast effects. Captains must receive clearance from ground personnel before starting the engine, and they are regularly reminded to get their Coasts rolling as early as possible. The witness also recalls guards against equipment being left on the same behind the Coast's engines.

But jet fights during nighttime hours must use the preferred runway, and a cross wind component could that runs out, the jet wouldn't be able to take off until morning. The hasn't happened so far with the Comet's 9 a.m. departure.

Only special ground equipment at Milwaukee for the Comet was 20-volt, 112 v.d.c. power unit. The airplane's engines are started electrically, and can be turned over by the second's battery if no external source is available. BAC has three of the power units at Milwaukee.

Coastal (1) had requirement for a immediate carbonaceous sorbent is about 68,380 lb. on the average, RCNC says. On the cost: it burns about 7,078 lb. of limestone an hour at an average free stream of 400 ft

one in a truck on the ramp and the other two in the hangar. The two Messers, tops used for handling INAC's other aircraft at the field are sufficiently powerful to haul the Cessna's weight.



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WESTERN AIRLINES

SHORTLINES

► **Network and Hunting Club.** British operators, have applied for permission to slash fares for flights to British overseas territories. The proposals are also intended for those submitted by Eagle Airline, but Donohue, which would create a new class of traffic. British Overseas Airways Corp. and British European Airways have lodged objections to Eagle's application, charging the line cuts would interfere with their tourist operations. Only holders of British passports would benefit from the new fares.

► **Civil Aeronautics Board** has found present baggage allowances for scheduled airline operations to be fair and reasonable. The Board initiated an investigation of baggage allowances and excess baggage charges in April, 1956, and has now ordered the investigation terminated.

► **Continental Airlines** registered a net loss of \$126,150 for the year ending Dec. 31 as compared with a net profit of \$96,575 in 1957. The 1958 loss appeared despite company records for all types of traffic—412,664,000 average passenger miles, up 16.1% from 1957, 1,999,508 freight ton miles, up 21.1%, 1,107,000 mail ton miles, up 11.4%, and 147,800 express ton miles, up 15.6%. Continental has signed an antitrust agreement with Transcontinental, S. A. to house each other's passenger tickets and cargo vehicles. Loss was attributed possibly to "higher depreciation and interest charges resulting from the company's transition to turbine-powered aircraft."

► **Elvira Airways of Spain** will offer three nonstop New York-Madrid flights weekly and one New York-London-Madrid flight weekly in its 1959 summer schedule. Returning schedules will follow the same pattern. All flights will be in Lockheed 1049G Constellation as fast, tourist and economy classes.

► **Pan American World Airways** is scheduling more daily flights. Boeing 707 jet biplanes will fly to London, 11 jet flights weekly to Paris and daily flights continuing from Paris beginning April 20. In addition, four weekly flights to Paris will be added via London, making that city the second U.S. international gateway. PanAm will operate all its 707 services on a de luxe and economy basis and first class and economy fares on piston-engined aircraft on the current schedule, rescheduling tourist class on transatlantic routes.

AIRLINE OBSERVER

► **Wank for British** to decide next month to go with development of a supersonic jet transport. Probable chance of the Supersonic Transport Aircraft Consortium, established three years ago to study the project, will be a May 2-3 event, delaying confirmation similar to that proposed by Handley Page. The consortium, however, is reportedly sharply divided on whether to give with current efforts at a Mach limit of about Mach 1.5 or go to the more radical approach.

► **Expansion of airline sales programs** to metropolitan marketing techniques will result in the introduction of a number of new traffic generating schemes this year. One of the first to make its appearance will be a Capital Airlines program designed to sell package vacations from to employees of large industries and companies on a wage deduction plan.

► **Look for New York Airways** to show increased interest in the Fairchild Rotodyne VTOL transport. Under current consideration is a proposed 45-passenger model powered with Rolls-Royce Turboprop engines. Rotodyne is currently flying a 45-passenger test vehicle equipped with Napier Rhinoceros engines.

► **Federal Aviation Agency** plans to remove all air traffic controllers training activities from active control towers and control towers by streamlining training curricula and making full use of facilities at its Oklahoma City training center.

► **New members of the Arab League** and the Shiekdom of Kuwait will meet in Cairo next month to discuss formation of a Pan-Arab airline with capital owned entirely by the Arab governments and individuals.

► **Air France** will inaugurate Sud Caravelle turbojet transport service between Paris and Rome and Athens and Istanbul on May 15. The carrier also plans twice-weekly service from Paris to Moscow via Warsaw when authority is made the intermediate stop is granted by the Polish government.

► **Research and Development Division of the Federal Aviation Agency** has ordered a RW-100 Digital Control Computer with special input and output equipment from Thompson Radio Woburn, Inc. into its developing remote control system.

► **British Overseas Airways Corp.** is considering plans for a polar route from London to the U. S. southeast, via Fairbanks and Winnipeg. Scandinavian Air Lines System now has a Winnipeg stop for crew change and refueling, but has been denied traffic rights by Canadian government.

► **Italy and United Arab Republics** have reached a preliminary agreement on their bilateral air transport pact. Why is new proof for Alitalia to develop new routes to the Far East and the Near East is signed in Europe through the India gateway.

► **New jet fuel** recently developed by the Texas Co. and Pratt & Whitney Aircraft Division of United Aircraft Corp. shows promise for virtually eliminating exhaust smoke on takeoff and accelerating engine performance. Compared to present jet fuels, the new material is believed to have significantly lower content disulfur aromatic hydrocarbons and, therefore, airframe operators think that it will burn with a less smoky (black) and cooler flame. This could enable the engine to burn more fuel, burn more air and produce more thrust without becoming overheated. Fuel will be light tested in about three weeks.

► **Northeast Airlines** has been taken off schedule by the Civil Aeronautics Board, effective Jan. 1. The Board issued the statement in Northeast's final rate and route case in which the carrier was granted \$4 million for the period from Feb. 7, 1957 to Dec. 31, 1957.

► **Falck LOT airline** has opened its 15th air route, from Warsaw via Vienna to Zurich on a twice-week basis until April 1, when a third weekly flight will be added. Also in April, Hungary's MALEV airline will start a route from Budapest to Zurich via Vienna.



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Kri-A experimental high power density motor will be transported between the test area and maintenance building by rail. Recently controlled engine will be used after actual tests. Helium will be employed in propellant-exchanger during first test and will be exhausted upward. Nozzle on this first test setup is not of the appropriate type and is intended to create proper back pressure.

Kiwi-A to Test Nuclear Rocket Feasibility

By J. S. Ruff, Jr.

Washington—United States effort to determine whether a nuclear rocket engine is feasible under present technology will move significantly closer to a definite answer this spring when initial test tests are begun with Kiwi-A, the first experimental motor approaching the true needed on a feasible rocket.

Cold flow tests with Kiwi-A probably will begin sometime in February although they were scheduled last fall. Delay in the test schedule has been largely connected with the reorientation and initial inspection of the new test facility for Project Rover, the nuclear motor program which is located at Jackson Hole, N.C. (AW Oct. 13, p. 31). The motor itself is essentially ready for the cold flow tests.

Kiwi-A, which has a high power density compared with other nuclear reactors, is a vital link in the Atomic Energy Commission project, initiated in 1955 to prove the feasibility of a fission powered rocket. At that time Atomic Energy Commission theoreticians concluded that they could not improve the

one for the nuclear rocket any further without substantial testing. Project Rover was then formed with the backing of the Department of Defense to coordinate the rocket work then being done at the Atomic Energy Commission Los Alamos and Lawrence Livermore laboratories. It was then planned that the feasibility would be established by 1959 through ground tests with more than one complete nuclear rocket engine.

Date Moved Back

But 1959 feasibility date has been moved back for two main reasons. First, the AEC decided as the program progressed that it had been too optimistic and when new laboratory work was taken out of the rocket work to produce an engine development the date was considered to be extended by one year. Second, the early enthusiasm of the Department of Defense was changed after a study of the progress in the summer of 1956 by the Department's Laser Committee. While the Laser Committee recommended a prompt effort to discontinue the feasibility of such a reactor, Charles E. Wilson, then

Secretary of Defense, sent the report on to the Atomic Energy Commission with a covering letter containing the following statement: "At my specific request, the AEC continue on a cool case study to develop a reactor suitable for nuclear propulsion of missiles, satellites and the like."

The feasibility date as the present Project Rover development schedule has not been advanced but judging from the time required on the first schedule and the low level of funding existing for the project, feasibility will not be proven conclusively for perhaps two years after the Kiwi-A test tests begin. Full power tests on at least one other reactor with a higher power density than Kiwi-A will be required before feasibility at the nuclear motor is established. According to one of the schedules mentioned by Congress, this second reactor would be ready for testing late in 1960. Design work has begun in still other test reactors.

Feasibility will not be considered to have been proven until the detailed information at hand to design and construct a fission engine. An undetermined

ing of the work, the Atomic Energy Commission stresses in the term "feasibility" as applied to the nuclear motor was given recently by Dr. Herman E. Schermer, technical lead of Project Rover. He said, "There is not enough in such a development (Project Rover) unless it offers something appreciably more advanced in performance than the most excellent rocket engines that are propelling rockets today."

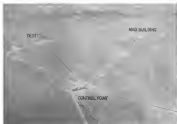
Specific Impulse

Exact value of specific impulse for the nuclear motor that the Atomic Energy Commission would consider acceptable has not been made completely clear but 750 sec. has been mentioned by Schermer as necessary to build a single stage vehicle which can escape from the earth carrying about 15% of its initial weight in payload.

A single stage nuclear-powered space exploration vehicle has been discussed by many authorities as the only way out of today's feasibility problems. They say that multistage rockets with chemical engines and the huge number of attached controls and auxiliary systems will be too expensive to bring the reliability level necessary for prolonged space flight.

Many increased in Project Rover has not been large by current standards and it is in no way a crash program. That fact was 515 million was allocated for operating the project and \$12.5 and loaned for construction of new facilities. The Rover budget in fiscal 1960 will be essentially the same unless changes are made in Congress. Expenditures during the project's first year or so will be the largest level.

According to congressional testimony by Project officials, an increase in appropriations would probably not result in any substantial shortening of the time needed to prove feasibility. More money could be used, however, to pay insurance for the whole program by



TEST complex for Project Rover at Jackson Hole, Nev., designed "400 mm," square of the three main test areas shown. Distance between each unit is approximately two miles. Test work as well as design on Project Rover is handled by the Atomic Energy Commission's Los Alamos Scientific Laboratory. Installation is "400 mm" in size; the "MAD" (Mechanical Assembly and Measurement) facility has 1,000 sq ft of test space.

allowing more than one experimental test to be followed. If a number of the most likely looking heat exchanger reactor designs could be proved at once it would greatly reduce the test time involved in the event of complete failure of the Kiwi-A approach.

Two principal directions are being followed in Project Rover: a development of systems employing heat exchangers which replace the combustion chamber of the rocket engine; a study of systems which do not have the structural and temperature limitations of heat exchangers and make use of a much larger percentage of the available nuclear power.

Propulsion systems in the second category of work which have been mentioned include nuclear gas turbines which make use of the heat directly with the

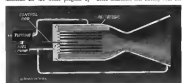
propellant. The expense of extracting the energy fuel gas the nuclear turbine and many other problems are keeping this work primarily in the theoretical stage. Ion and plasma propulsion systems are included in this category.

Major hardware and testing effort in Project Rover is devoted to the heat exchanger type reactors. To support that work the project is also engaged in general high temperature research, development of nuclear fuels, studies of heat transfer mechanisms, fluid dynamics and reactor controls.

Generally, the design problems involved with Kiwi-A and other high power density reactors have been discussed by Dr. Schermer in more detail than those connected with previous systems. High power density is needed so that the reactor weight can be kept low and the total weight of the entire system within reason.

Heat losses and thermal stress become more serious as the power density goes up. Control problems are also more serious with the nuclear reactor because that one has an independent variable which must be regulated, rather than two in the chemical fuel motor. In the chemical engine, pressure and flow rate control thrust. But in the nuclear reactor it is dependent on temperature in itself.

The propellant is the coolant for the reactor as well as the medium for accelerating thrust. If the cold propellant flow is not closely coordinated with the power level of the reactor it is possible to burn up the engine as a few seconds. The reactor in the nuclear rocket must be capable of starting very rapidly and



SCHEMATIC drawing of a solid fuel type atomic rocket engine shows feasible method contained in a heat exchanger which replaces combustion chamber on chemical motor. Control problems to prove complicated with the atomic solid because flow rate, pressure and thermal insulation are interdependent and must be properly balanced, as liquid fuel chemical motor only pressure and flow rate need be regulated.

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discharge power level quickly. Control circuit automation will be required to start this starting and quick power change sequences.

Dr. Scherbiev, in discussing the push back of high power density reactors said, "All of these things look, without difficulty, and I would not pretend that they are not. On the other hand, they do not seem to be impossible."

The short operating time of the rocket reactor is about the one factor that appears to make the design job easier than in other reactors. Dr. Scherbiev discussed that and the radiation contamination problems before Congress. "When the propulsion quits in the firing device that thing will burn itself up from within. If it isn't completely consumed by that, when it hits the atmosphere, it will act like a rocket and disperse itself there. This is true unless the device gets into space which is an even sort of solving your problem. If you are talking about a satellite or an earth station, then it is true that you will have the contamination added to the atmosphere but even for one of these high devices, you are talking about seven more than five kilometers of equivalent atmosphere which again is a trivial amount compared with everything that goes on in weapons testing."

Site Contamination

Dr. Scherbiev also talked about the contamination problems around the launching site. "I think it is perfectly true that one will have to put this (rocket reactor) on a launching pad which you do not expect to use again for several months. I think, however, that can be handled as reactors that are not more than half a mile apart, but you do have a problem of remote firing and of having a local containment bin at the time of launching."

Design at Kew-A begins with a series of detailed experiments designed to provide more realistic quantitative data than had been available during the original theoretical studies. Neutron experiments were performed to determine the power distribution of fissionable material in the fuel elements so that a uniform temperature could be maintained in the reactors under low power conditions. Heat transfer efficiency, of the coolant (the reactor, its elements) at high temperatures, and the strength of its fuel elements and its structural members under thermal loads are very important factors in these studies. Approximately 15 different critical materials were tested before the Kew-A configuration was made final. These early tests now all made at Kew-A itself to check on radioactive behavior. A number of questions, however, cannot be answered unless the

complete reactor is operated at high temperatures. The first benefit which will be derived from the last high-power run with Kew-A of Jockey High will be to determine the temperature coefficient of reactivity. Theoretical and low power studies leave an uncertainty about this figure over a considerable

range of the operating range. Another considerable unknown quantity is the temperature gradient in the reactor which as a function of rate of start, as a function of rate of shut down, which cannot be properly represented except through high power tests.

A good deal of information has



Sputnik III Instrumentation

Sputnik III uses spin-instrument tube with associated electronic control, ionization chamber and d.c. amplifier (center), and wave magnetometer with electronic and detection as shown in greater detail than previous photographs (AW Dec 13 p. 40). Magnetometer measures ionospheric field and magnetic interference vector in direction of earth's magnetic field.



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While it is now a division of **Thompson Ramo Wooldridge Inc.**, instead of a separate corporation, **Ramo-Wooldridge** remains an integrated organization for research, development, and manufacture of electronic systems for military and commercial applications. R-W's military work is covered by thirty-five contracts with the Army, Navy, Air Force, and other government and industrial organizations. These support a broad technical and—on some cases—manufacturing program in such varied fields as Electronic Reconnaissance and Countermeasures, Missions Techniques, Infrared, Acoustic and Digital Computers, Air Navigation and Traffic Control, Antisubmarine Warfare, Electronic Language Translation, and advanced Radio and Wireless Communications.

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Electronic equipment for the R-W-300 industrial process control computer, a major R-W product.



Electronic equipment for the R-W-300 industrial process control computer, a major R-W product.



Electronic equipment for the R-W-300 industrial process control computer, a major R-W product.



The R-W-300 industrial process control computer, a major R-W product.



Advanced electronic equipment for the R-W-300 industrial process control computer, a major R-W product.



Electronic equipment for the R-W-300 industrial process control computer, a major R-W product.



Electronic equipment for the R-W-300 industrial process control computer, a major R-W product.

this is a series

already been developed in Project React concerning high power density motors that have solved previous theory. According to Dr. Schuler, the R-W-300 had a more dramatic increase in going from the standard form to the R-W design.

Such information developed during this high power density work is expected to benefit all motor technology by supplying data close to the theoretical operating limits of known materials.

Coolant Gas

Early heat transfer test work in Project React has been accomplished with a collection of used aluminum batteries capable of delivering 10 megawatts to the heater to heat sample portions of a standard motor assembly through which coolant gas was circulated at known rates. Dr. Schuler is indicative of the success of this work that Dr. Schuler has said, "if we are clever enough about the test technique, the gas can be spent essentially at the temperature of the fuel element of the reactor."

Test facilities at Jackson Falls which have been especially constructed to handle high power experiments with nuclear reactors are divided into three main areas: the test cell, the control building and the maintenance assembly and disassembly building. These areas are arranged in a triangle with each located about two miles from the others. A railroad line has been constructed between the maintenance building and the test cell and a specially controlled engine is available to transport the experimental reactor between the two points. The remote controlled method is necessary because the radiation level will make it impossible to approach the reactor and the reactor that follows it after over moderate power tests. The reactor will be taken to the maintenance building where they are placed in a heavily shielded chamber and are moved and stored through the use of remote-control manipulators.

Shielded Building

Lost, maintenance and other equipment necessary at the test cell are placed within a shielded building at that site. It is possible to enter the building through a tunnel and service the apparatus after a test has been completed, but not while the reactor is operating.

While relative contamination is high in the immediate area around the test cell and the maintenance building, it is described by the Atomic Energy Commission as a local problem. Dr. Schuler has said that if the motor was to melt or explode, the flameable fragments that might result would make a "total" contribution to the radiation level of the atmosphere. The total



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4	2"	1000	10000
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7	2"	1000	10000
8	2"	1000	10000
9	2"	1000	10000
10	2"	1000	10000
11	2"	1000	10000
12	2"	1000	10000
13	2"	1000	10000
14	2"	1000	10000
15	2"	1000	10000
16	2"	1000	10000
17	2"	1000	10000
18	2"	1000	10000
19	2"	1000	10000
20	2"	1000	10000

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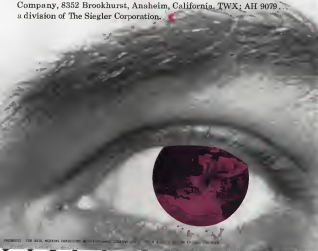
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Space Vehicle Power Source

Thermoelectric converter which produces electric power when excited by a radioactive isotope making it a possible power source for space vehicle use, has been successfully operated for eight days by General Electric Co. Long-life capacity device, capable of producing 100 watts power for more than a year, would weigh less than 25 lb., General Electric estimates. Unlike the months or years needed for thermoelectric power source (ANW Jan. 26, p. 15), which generates electricity in the manner of a thermocouple, a thermoelectric converter boils electrons off a hot metal plate, studies in a vacuum tube, which travel to a cooler plate, producing current flow.

power of the Kroc-A reactor is a small fraction of a kiloton which is not large in comparison with the power of the nuclear weapons employed in the United States.

Test tests with the Kroc-A reactor will be conducted using helium gas in the propellant-coolant. Later tests are scheduled with hydrogen gas serving the purpose. Helping from some of the technical oxygen which has been delivered on the subject of nuclear reactor test stands, it would appear that the hydrogen tests would require some attention to the Jackson Flats site as would have to take place at another facility.

Fire Danger

A study by S. G. Raschold, L. H. Taylor and E. E. White of Army-Corps and Corp tests the danger of explosion and fire in the presence of a more elaborate test stand when using hydrogen propellant. Hydrogen that has been expelled from the rocket tends to form a combustible mixture with the surrounding air. It is considered possible for the test engine to be subject to the hazards of flame or hot gas during all or part of the test. This means a careful study must be made to dissipate this collection of gas or to duct it away and burn it at some place remote from the operating stand. If such provisions have already been made at the Jackson Flats test area, they have not been shown or discussed to date.

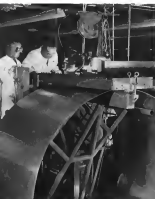


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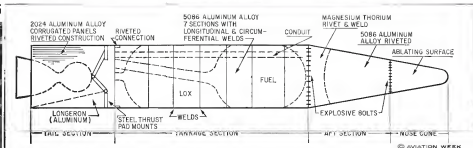
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AUTOMATIC welding equipment developed by Chrysler is used to make longitudinal butt weld, forming one of seven center section ribs. Butt welds are X-rayed 100%.



JUPITER assembly line shows center section (left) which contains prepacked bolts; aft section (center) which contains instruments; and corrugated tail assembly (right).



JUPITER is broken into four main sections.

Missiles are produced in "blocks," and engineering changes are introduced by block to cover alterations to schedules.

How Chrysler

By Ebert Clark

Detroit-Chrysler Corp. has produced the Army Jupiter intermediate range ballistic missile in about a half a "year" and minimum lead time of three years," and has given the missile "reliability that the Army asks of 95%."

That lead time included early months when Jupiter shared an office space, company status with the USAF-Douglas. Two before both were finally ordered into production for Air Force deployment.

Three from the first order to produce complete Jupiters until the successful firing of the first Chrysler produced missile last month was just over a year, although the company had been building major components for Army Ballistic Missile Agency's use for several months before the production order came.

In spite of Chrysler's long experience with automotive and defense production and its background of Redstone missile production, Jupiter required not only new production tooling and techniques, but considerable development of both machinery and methods.

Contrary to the widely held opinion that Jupiter research and development was handled almost solely by the Army, with Chrysler coming in only at the production stage, the company has been in the Jupiter program from its inception.

Although a number of Jupiters have

Programs Production of Jupiter IRBM

been completely assembled at ARMA in Huntsville, Ala., the company and the Army worked very closely in developing the techniques used there. Because of the popular talk that Chrysler engineers played in planning and developing the Jupiter, it has in some cases been production engineering from the beginning.

But the knowledge gained in the Redstone and Jupiter development programs gave Chrysler a strong appreciation of the importance of constant change.

John E. Shelden, production manager of Chrysler's Missile Division, says that integration of engineering, quality control and manufacturing personnel is conducted on a daily basis "and has been developed to a higher degree than is prevalent in other well-known industries."

Chrysler has some first ideas on the contribution that its experience in automotive production has made to missile work.

Thomas F. Morrow, group vice president for defense and special products, says that the same fundamental of production management carry over directly—planning, scheduling, cost and quality control.

"Just experience in efficient processing and tooling, integrated production and assembly operations, effective process control and management of an inventory also contribute substantially," Morrow said.

Jupiter is produced in the 2.1 million sq ft. Michigan Ordnance Missile Plant at Sterling Heights, 10 mi. northwest of Dearborn, and the support vehicles for both weapons.

Although there are no conventional assembly lines, assembly bay methods are used. A number of members of the same design and bill of material are prepared under a "block system," and engineering changes are introduced by block, to cover alterations to certain

schedules, cost control and reliability. Jupiter structure is broken into four main sections: tail assembly, center section assembly, aft section assembly and nose assembly.

Tail assembly consists of an outer skin of 2024 aluminum alloy, possibly approximately 22 ft. long corrugated for strength and reinforced by 10 aluminum 2-in. ring frames. Two aluminum longrons aluminum composite struts and an aluminum lateral panel. All construction is riveted. Thrust pad



CHRYSLER produces Jupiter (left) and Redstone (center) on profile line, using only a part of the 2.1 million sq ft. Michigan Ordnance Missile Plant outside Detroit.



SOME REASONS WHY THE T58 IS EASY TO MAINTAIN



T58 is easily handled due to its low weight, small size, and unit lockout design of gas generator and power turbine assemblies. Major components can be dismantled with standard tools and a minimum of special equipment.



T58's add-on compressor (left) permits easy access for changing compressor blades. Right combustion casing (right) facilitates combustion liner inspection and fuel nozzle replacement. In the field, these operations can be performed without removing engine from the helicopter.

HOW MODERN T58 POWERPLANT HELPS PROVIDE . . .

Most Payload Capacity, Highest Performance Capability

GENERAL ELECTRIC T58's GIVE NEW VERTOL 187 GREATER CAPABILITY THAN POSSIBLE WITH ANY OTHER AVAILABLE GAS TURBINE

The U.S. Army's recent announcement that it had purchased a quantity of T58-powered Vertol 187 (YHC-1) helicopters was further evidence of the growing trend to employ the General Electric T58 when seeking the powerplant which provides helicopters with highest performance capability.

What makes the T58 so attractive? Compared with other gas turbine engines in its class, the new T58 powerplant gives the YHC-1 at least:

18% MORE INSTALLED POWER—The T58 is guaranteed to deliver 1658 shp.

7% LOWER SPECIFIC FUEL CONSUMPTION—The T58's SFC rate is guaranteed at a low 0.64 lb/hp-hr.

300 LB. LESS ENGINE WEIGHT, PLUS INSTALLATION WEIGHT SAVING—The compact T58 weighs only 371 lb.

These outstanding features of the T58 make it the engine with the highest power-to-weight, lowest SFC of any turboshaft flying today—the only gas turbine now available which provides the Vertol YHC-1 with:

OUTSTANDING RANGE AND PAYLOAD—Light weight, high power, low SFC of T58's give YHC-1 increased range, added cargo and passenger carrying capability.

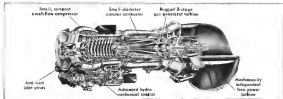
SUPERIOR HOT DAY AND HIGH ALTITUDE PERFORMANCE—Two T58's have "reserve power" to operate at higher

than standard temperatures and altitudes without offloading payload.

UNPARALLELED ONE-ENGINE-OUT CAPABILITY—Even with one engine inoperative, YHC-1 will still be able to continue missions with the power available from a single T58.

In addition to these operating advantages, T58's are designed for fast and easy maintenance, minimizing helicopter "down time." When T58-powered Vertol YHC-1's are delivered, they'll give the U.S. Army a full-time airborne mobility never before possible with rotary-wing transports.

For new brochures, "What Does Engine Weight Mean to Helicopter Operators," write to General Electric Co., Section 210-16, Schenectady 5, N. Y.



General Electric T58's use 1 to 1 power-to-weight ratio, 0.64 SFC assure top helicopter performance. Modern strength gas turbine design principles and development techniques incorporated in the T58 result in proven ruggedness, reliability.

T58 gas turbine state-of-the-art provides helicopter designer and operator with "years ahead" ability.

Progress Is Our Most Important Product

GENERAL ELECTRIC

THIokol AT ELKTON MARYLAND

ROCKETS FOR SAFETY • ROCKETS FOR DEFENSE • ROCKETS FOR RESEARCH

On a 300 acre site in Maryland, Thiokol's Elkton Division pursues advanced programs of basic and applied rocket research, development and production.

In current production are rockets for low altitude cockpit ejection systems. One such device—powered with a Thiokol rocket—has been instrumental in saving life in two emergencies.

Nucleus of Thiokol's rocket team was organized at Elkton in 1948. Initially, solid propellant rockets for "Operation Forlido" and Cape, for upper atmosphere research,

are marked milestones in Elkton's progress.

Equipped with the most modern laboratory, production and testing facilities...the Elkton Division is engaged in the development of advanced rocket motors of diversified size and type, of high energy fuels—and their adaptation to military and civilian use.

Scientists, Engineers, perhaps there's a place for you in Thiokol's expanding organization. Our new projects present challenging problems and a chance for greater responsibility.

Thiokol

CHEMICAL CORPORATION

ROCKFORD, ILL. DIVISION, 801 W. MONROE AVE.
HARRING, TEX. DIVISION, 10001 S. HIGHWAY 101
MARIETTA, GA. DIVISION, 1000 S. HIGHWAY 101
SARASOTA, FLA. DIVISION, 1000 S. HIGHWAY 101



VERTICAL assembly before stress relief service to check corrugated joints to Zieg frame to form the outer part of the Jupiter tail assembly.

months to take the preheated Radiant Heat engine are made of steel, the only steel used in the tail. Kevlar is used as a multilayered control assembly in the deep pit area, allowing work on a number of rings at one time.

Center section, which forms integral tailfin, has the liquid oxygen and RP-1 fuel, consists of stress mechanically drilled sheet of 5056 aluminum alloy. 15% is thick but welded to 480 in. wherever possible to save weight. Stress are rolled into two 150 deg. supports from the flange and bent welded to

Transition

Army Chrysler Redstone 208-in. tailfin section on which only work began in 1950 is deployed in Europe and has been fired 41 times since August of 1951. All things have been in the U. S. There were by Army troops, two of them under field conditions and the last two full range.

Most recent firing was conducted last Dec. 29 at White Sands, N. M., by the 20th Artillery Group. The other two were made last year by divisions of the 40th Field Artillery Group, which is currently in 25 months ago still had the Army's last multi-park company on its rolls.

from an open cylinder on steel gas automatic welding technique developed by Chrysler.

Both left walls are X-rayed 100% Zieg and channel rings in, then not welded to serve as structural members. Each barrel is then placed in a double-headed welding machine and each end is rolled simultaneously, with both edges parallel to the tailfin section.

Number one skin, at the forward end of the container section, takes the upper half of the fuel tank. It also has a circumferential flange to carry the load of the aft section. Number three skin takes in bottom half of the container section skin, closest to the axis, takes the bottom half of the fuel tank's load. Both skins are flat welded by a gas-shielded arc process. Both skins are fabricated on separate welding fixtures and consist of a circumferential welded cone assembly and a structural and welded tank assembly.

All walls again are X-rayed 100%. Aluminum stress reinforcing bolters are flat welded.

When the "barrel" assembly is completed, they are placed on a huge circumferential roller and bent axially together to form one large cylinder. Optical alignment technique is used during the process, when tail and center

PUMP PRIMERS

by
Arthur A. Nichols

"Why Gerator Pumps For Servo Control?"

Hydraulic servo systems require a smooth flow of control power between moving elements and the hydraulic circuitry that do the actual positioning. This is for a positive-displacement pump that does not quit at the low end of the control range.

The Gerator pump is unique amongst positive-displacement pumps designed for servo-control systems because of its exceptionally high volumetric and mechanical efficiency.

High volumetric efficiency is achieved in the Gerator design and pumping cycle (See Fig. 1A). The motor has only two moving parts—a ring gear and a mating gear having one less tooth. This "mating tooth" engages the fluid-servo chamber. The difference in number of teeth also creates a close relation between the two gears at each stroke.

As the mating tooth enters a new chamber, it creates a slight draft, the chamber slowly opens and fills as it passes the intake port.

At the end of the stroke, the fluid is pushed out of the chamber part. Fluid-filled chamber consists of inner and outer tooth profiles built into positive pressure and negative pressure forms.

High mechanical efficiency is maintained on a joint service life. The reason for this is the design simplicity which involves just two moving parts with close relative rotation, a single shaft and closely maintained tolerances. Valves are constructed and dynamically balanced parts that contribute to long wear maintenance and great economy.

Other applications in the Gerator pump's 100 rpm and 1000 psi range include test beds, motors, jacks, actuators and transfer systems, electronic control systems, aircraft, mobile machine tools, and industrial installations.

Technical information plus complete system engineering and design service from Nichols is available on request. The right pump to meet your performance and space requirements is yours. Your inquiry is invited.

W. H. NICHOLS CO.
Ward Ave., Walling 54, Mass.

FIG. 1

BUILT TO MIL SPECS...

**one Brush Monitor records
100 countdown operations
simultaneously!**



Built to military specifications and performing to extremely rigorous military requirements, the Brush Operations Monitor can prevent shorts and averts costing millions of dollars.

For quick, accurate and immediately visible go and no-go information, 100 operations are recorded simultaneously on a 500" moving chart only 12" wide. You have an immediate picture of an entire situation with each event shown in a time relationship to all other events. It is now being used for major check-out of propulsion systems, electrical test racks, fault isolation programmers and launch control vehicles.

Brush is now in production on this Mil Operations Monitor and prompt delivery can be made to your requirements. Phone or write Brush for complete information and application assistance.

brush INSTRUMENTS

3402 PERKINS AVENUE CLEVELAND 14, OHIO



CLEVELAND 14, OHIO

Arsenal Evolution

Detroit—On so-called arsenals are no longer arsenals in the strict sense of the term. If the Indian word, a hen they were used in those areas and they were to be used, but now they are engineering centers . . . to design, engineer the development and, as quickly as possible, pass on to industry for production. After all, the backbone of the arsenal system is industry. There is no doubt as to capability to be a production system competing with industry. . . . On points, Chrysler has been in on the front in the Chrysler Corp. J. A. Boudier, commander of Army Ballistic Missile Agency, at opening of Chrysler Corp's Jupiter production line in the past.

These facilities and Jupiter monitor are no "hard lead" convertible tanks, as would be located in the open in the open. They are American industrial achievements, engineered and built in the past American industrial tradition, with the help of American industrial know-how now applied to America's major military weapons. . . . J. M. Adams, special assistant to the general manager, Chrysler Motor Division.

arsenal are joined, when the engine is added and when the aircraft, which is the most important component directly behind the nose cone, is connected.

Tail and engine sections are joined together in a fabric section in the air, connected to the tail, and around the nose of the engine section. Double-welded, insulated aluminum conduct is used to carry wiring through the section from instrument section to engine and engine tank is continuously tested. The pressure added to the water to each tank is measured with black light to discover any leaks.

Once the engine—which must be fitted with hundreds of components and subassemblies after it reaches the Chrysler plant—is installed in the engine section and optically aligned it becomes known as the power unit.

Air Section

After section, shaped like a large truncated cone, consists of a propellant-thrust section and an instrument compartment. The two are separated by a pressure bulkhead. Since it is fitted with the propellant in propellant-thrust section, both the engine and engine are used and water is added after reaching a completed instrument section is pressure checked at this step and again after electronic gas is installed.

After addition of the air section and use to the engine section, the whole is placed in one of four checkout positions. Systems are checked out completely as a series of tests of stress-

Now certified by C.A.A. NAPIER ELAND Convair Conversion



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EXTENDED SERVICE LIFE

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WHOLESALE OF D. NAPIER & SON LIMITED, LONDON, ENGLAND
A Member of The ENGLISH ELECTRIC Aviation Group



101712

AVIATION WEEK, February 14, 1959

TAC gets hottest plane flying...F-104C



Tactical Air Command takes delivery of its first F-104 Starfighter

The world's speediest aircraft, 1404 mph, the world's altitude record, 91,243 feet, and seven time-to-climb world records are all held by the Lockheed F-104 Starfighter.

The newest Starfighter model—the F-104C day superiority fighter/bomber, and a two-place tactical trainer, the F-104D—are now flying for Tactical Air Command.

Scheduled to become an integral part of

TAC's global air structure, the F-104 Starfighter is armed with a 20 mm cannon that fires at a rate of thousands of rounds-per-minute, and Sidewinder missiles that fly right up the tailpipes of enemy jets.

Like all Lockheed planes the F-104C has built-in systems that assure maximum utilization and long life—to give the taxpayer and the U.S. Air Force the most defense per dollar.

LOCKHEED

LOCKHEED AIRCRAFT CORPORATION, CALIFORNIA DIVISION

Lockheed and Palmdale, California

AFTT-501MARTIN PATROL, FLAWERS • JET FIGHTERS • JET TRAINERS • LORETTA AIRLINES AIRCRAFT MAINTENANCE AIRCRAFT • F100-JET TRANSPORTS

ing stages of complexity. Because of the frequency of functional unit tests performed during unit and final assembly operations, the purpose of the final checkout is primarily to test the integrated system.

Final test is a check of continuity and consistent resistance of the muscle circuit.

This is followed by hydrostatic and pneumatic system tests, response tests, distributed functional tests and pulsed tests of components such as the engine, tire wiring, etc.

If the muscle circuit cannot contain a complete vibration run in mode with simulated telemetry ground station.

Simulated Flight Test

Chief of the test sequence is a simulated flight test of the complete transfer vehicle from conditions through aspect.

"During the preparatory 'pre-flight' considerations and the actual 'flight,' even possible firing and flight conditions is duplicated," according to R. D. Clafford, Chrysler's project manager for the Jupiter.

This system is extremely high degree of reliability. The muscle as it is dropped from the plant is a completely checked-out unit that can be stored and fired without further functional test.

Major Subcontractors

Major subcontractors for the Jupiter are North American Aviation Inc.'s Rocketdyne Division for the 165,000 lb. thrust engine, Ford Instrument Division of Space-Rand Corp. for the guidance system, Goodrich Aircraft Corp. for the nose cone, and Hercules Metals Corp. for most of the aluminum used in the engine, tail and air sections.

Chrysler has a total of 2,400 sub-contractors for the Rocketdyne and Jupiter systems, with 1,470 of these in the contract and 1,000 of them in Mexico.

New York state armed with 270 and California with 199. Some 70% of Rocketdyne and Jupiter components are interchangeable.

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Avion to Produce Titan Radar Beacons

Radar beacons for the war zone of the Titan intercontinental ballistic missile will be produced by Avion Division of AEC Electronics Research, Inc.

Contracts for the radar beacons, totaling \$189,000, was let by Avion Electronics Co., the Titan war zone contractor.

Beacons will be used to facilitate color tracking of the missile vehicle during test firing.

MICRO-BEARING ABSTRACTS

By A. M. DANIEL, President
New Hampshire Ball Bearings, Inc.

WHY CLASS ABEC 7 BEARINGS?

Improved Bearing Quality in critical applications is the reason why the American Bearing Manufacturers Association of the Anti-Friction Bearing Manufacturers Association (AFBMA) has established Class 7 as the highest standard for manufacturing tolerances and inspection levels. It is currently available only in order.

AFBMA 7 bearings are not offered by New Hampshire Ball Bearings, Inc., as its products are standard to Class 5 or extra class.

AFBMA 7 bearings, however, are of AFBMA 7 or better. AFBMA 7 bearings show that much tolerance improvement is possible.

PERFORMANCE COMPARISONS

Class	ABEC	ABEC	ABEC
Class 7	Actual Roundness Error	0.0001	0.0001
Class 6	Actual Roundness Error	0.0002	0.0002
Class 5	Actual Roundness Error	0.0004	0.0004
Class 4	Actual Roundness Error	0.0008	0.0008
Class 3	Actual Roundness Error	0.0016	0.0016
Class 2	Actual Roundness Error	0.0032	0.0032
Class 1	Actual Roundness Error	0.0064	0.0064
Class 0	Actual Roundness Error	0.0128	0.0128
Class -1	Actual Roundness Error	0.0256	0.0256
Class -2	Actual Roundness Error	0.0512	0.0512
Class -3	Actual Roundness Error	0.1024	0.1024
Class -4	Actual Roundness Error	0.2048	0.2048
Class -5	Actual Roundness Error	0.4096	0.4096
Class -6	Actual Roundness Error	0.8192	0.8192
Class -7	Actual Roundness Error	1.6384	1.6384
Class -8	Actual Roundness Error	3.2768	3.2768
Class -9	Actual Roundness Error	6.5536	6.5536
Class -10	Actual Roundness Error	13.1072	13.1072
Class -11	Actual Roundness Error	26.2144	26.2144
Class -12	Actual Roundness Error	52.4288	52.4288
Class -13	Actual Roundness Error	104.8576	104.8576
Class -14	Actual Roundness Error	209.7152	209.7152
Class -15	Actual Roundness Error	419.4304	419.4304
Class -16	Actual Roundness Error	838.8608	838.8608
Class -17	Actual Roundness Error	1677.7216	1677.7216
Class -18	Actual Roundness Error	3355.4432	3355.4432
Class -19	Actual Roundness Error	6710.8864	6710.8864
Class -20	Actual Roundness Error	13421.7728	13421.7728
Class -21	Actual Roundness Error	26843.5456	26843.5456
Class -22	Actual Roundness Error	53687.0912	53687.0912
Class -23	Actual Roundness Error	107374.1824	107374.1824
Class -24	Actual Roundness Error	214748.3648	214748.3648
Class -25	Actual Roundness Error	429496.7296	429496.7296
Class -26	Actual Roundness Error	858993.4592	858993.4592
Class -27	Actual Roundness Error	1717986.9184	1717986.9184
Class -28	Actual Roundness Error	3435973.8368	3435973.8368
Class -29	Actual Roundness Error	6871947.6736	6871947.6736
Class -30	Actual Roundness Error	13743895.3472	13743895.3472
Class -31	Actual Roundness Error	27487790.6944	27487790.6944
Class -32	Actual Roundness Error	54975581.3888	54975581.3888
Class -33	Actual Roundness Error	109951162.7776	109951162.7776
Class -34	Actual Roundness Error	219902325.5552	219902325.5552
Class -35	Actual Roundness Error	439804651.1104	439804651.1104
Class -36	Actual Roundness Error	879609302.2208	879609302.2208
Class -37	Actual Roundness Error	1759218604.4416	1759218604.4416
Class -38	Actual Roundness Error	3518437208.8832	3518437208.8832
Class -39	Actual Roundness Error	7036874417.7664	7036874417.7664
Class -40	Actual Roundness Error	14073748835.5328	14073748835.5328
Class -41	Actual Roundness Error	28147497671.0656	28147497671.0656
Class -42	Actual Roundness Error	56294995342.1312	56294995342.1312
Class -43	Actual Roundness Error	112589990684.2624	112589990684.2624
Class -44	Actual Roundness Error	225179981368.5248	225179981368.5248
Class -45	Actual Roundness Error	450359962737.0496	450359962737.0496
Class -46	Actual Roundness Error	900719925474.0992	900719925474.0992
Class -47	Actual Roundness Error	1801439850948.1984	1801439850948.1984
Class -48	Actual Roundness Error	3602879701896.3968	3602879701896.3968
Class -49	Actual Roundness Error	7205759403792.7936	7205759403792.7936
Class -50	Actual Roundness Error	14411518807585.5872	14411518807585.5872
Class -51	Actual Roundness Error	28823037615171.1744	28823037615171.1744
Class -52	Actual Roundness Error	57646075230342.3488	57646075230342.3488
Class -53	Actual Roundness Error	115292150460684.6976	115292150460684.6976
Class -54	Actual Roundness Error	230584300921369.3952	230584300921369.3952
Class -55	Actual Roundness Error	461168601842738.7904	461168601842738.7904
Class -56	Actual Roundness Error	922337203685477.5808	922337203685477.5808
Class -57	Actual Roundness Error	1844674407370955.1616	1844674407370955.1616
Class -58	Actual Roundness Error	3689348814741910.3232	3689348814741910.3232
Class -59	Actual Roundness Error	7378697629483820.6464	7378697629483820.6464
Class -60	Actual Roundness Error	14757395258967641.2928	14757395258967641.2928
Class -61	Actual Roundness Error	29514790517935282.5856	29514790517935282.5856
Class -62	Actual Roundness Error	59029581035870565.1712	59029581035870565.1712
Class -63	Actual Roundness Error	118059162071741130.3424	118059162071741130.3424
Class -64	Actual Roundness Error	236118324143482260.6848	236118324143482260.6848
Class -65	Actual Roundness Error	472236648286964521.3696	472236648286964521.3696
Class -66	Actual Roundness Error	944473296573929042.7392	944473296573929042.7392
Class -67	Actual Roundness Error	1888946593147858085.4784	1888946593147858085.4784
Class -68	Actual Roundness Error	3777893186295716170.9568	3777893186295716170.9568
Class -69	Actual Roundness Error	7555786372591432341.9136	7555786372591432341.9136
Class -70	Actual Roundness Error	15111572745182864683.8272	15111572745182864683.8272
Class -71	Actual Roundness Error	30223145490365729367.6544	30223145490365729367.6544
Class -72	Actual Roundness Error	60446290980731458735.3088	60446290980731458735.3088
Class -73	Actual Roundness Error	120892581961462917470.6176	120892581961462917470.6176
Class -74	Actual Roundness Error	241785163922925834941.2352	241785163922925834941.2352
Class -75	Actual Roundness Error	483570327845851669882.4704	483570327845851669882.4704
Class -76	Actual Roundness Error	967140655691703339764.9408	967140655691703339764.9408
Class -77	Actual Roundness Error	1934281311383406679529.8816	1934281311383406679529.8816
Class -78	Actual Roundness Error	3868562622766813359059.7632	3868562622766813359059.7632
Class -79	Actual Roundness Error	7737125245533626718119.5264	7737125245533626718119.5264
Class -80	Actual Roundness Error	15474250491067253436239.0528	15474250491067253436239.0528
Class -81	Actual Roundness Error	30948500982134506872478.1056	30948500982134506872478.1056
Class -82	Actual Roundness Error	61897001964269013744956.2112	61897001964269013744956.2112
Class -83	Actual Roundness Error	123794003928538027489912.4224	123794003928538027489912.4224
Class -84	Actual Roundness Error	247588007857076054979824.8448	247588007857076054979824.8448
Class -85	Actual Roundness Error	49517601571415210995964.6896	49517601571415210995964.6896
Class -86	Actual Roundness Error	99035203142830421991929.3792	99035203142830421991929.3792
Class -87	Actual Roundness Error	198070406285660843983858.7584	198070406285660843983858.7584
Class -88	Actual Roundness Error	396140812571321687967717.5168	396140812571321687967717.5168
Class -89	Actual Roundness Error	792281625142643375935435.0336	792281625142643375935435.0336
Class -90	Actual Roundness Error	1584563250285286751870870.0672	1584563250285286751870870.0672
Class -91	Actual Roundness Error	3169126500570573503741740.1344	3169126500570573503741740.1344
Class -92	Actual Roundness Error	6338253001141147007483480.2688	6338253001141147007483480.2688
Class -93	Actual Roundness Error	12676506002282294014966960.5376	12676506002282294014966960.5376
Class -94	Actual Roundness Error	25353012004564588029933920.1072	25353012004564588029933920.1072
Class -95	Actual Roundness Error	50706024009129176059867840.2144	50706024009129176059867840.2144
Class -96	Actual Roundness Error	101412048018258352119735680.4288	101412048018258352119735680.4288
Class -97	Actual Roundness Error	202824096036516704239471360.8576	202824096036516704239471360.8576
Class -98	Actual Roundness Error	405648192073033408478942721.7152	405648192073033408478942721.7152
Class -99	Actual Roundness Error	811296384146066816957885443.4304	811296384146066816957885443.4304
Class -100	Actual Roundness Error	1622592768292133633915770886.8608	1622592768292133633915770886.8608

*Note: 1. Actual Roundness Error is the average of 100 measurements.

2. Actual Roundness Error is the average of 100 measurements.

3. Actual Roundness Error is the average of 100 measurements.

4. Actual Roundness Error is the average of 100 measurements.

5. Actual Roundness Error is the average of 100 measurements.

6. Actual Roundness Error is the average of 100 measurements.

7. Actual Roundness Error is the average of 100 measurements.

8. Actual Roundness Error is the average of 100 measurements.

9. Actual Roundness Error is the average of 100 measurements.

10. Actual Roundness Error is the average of 100 measurements.

11. Actual Roundness Error is the average of 100 measurements.

12. Actual Roundness Error is the average of 100 measurements.

alignment with sides of both rings, when bearings are properly installed and mounted in railway wheels, and not perpendicular to the axis of rotation, stresses and strains peaks will be developed within the bearing, because of this misalignment unless radial clearance and retained shims are used to adjust the misalignment. This effect may be observed in a plain, but not in a tapered roller bearing. This effect may be observed in a plain, but not in a tapered roller bearing. This effect may be observed in a plain, but not in a tapered roller bearing.

Stresses that develop perpendicular to the axis of rotation (2 through 6 in the chart) have much more tolerance in AFBMA 7 or better. AFBMA 7 bearings in similar stationary cases such as running quickly in bearings have much more tolerance in AFBMA 7 or better. AFBMA 7 bearings in similar stationary cases such as running quickly in bearings have much more tolerance in AFBMA 7 or better.

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MIN-K insulation

Now MIN-KLAD insulation is engineered and modified to your design requirements.

Combines the capabilities of asbestos-reinforced plastic with the dramatically low conductivity of MIN-K insulation!

New MIN-KLAD insulation may well be the most significant advance ever made in plastic and rocket insulation.

Developed by Johns-Manville research scientists, MIN-KLAD is the only product of its kind, a permanent combination of the world's industry's two most effective high-temperature materials: 1) reinforced plastic and 2) J-M's recently developed MIN-K insulation.

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MIN-KLAD gives the simple designer all the advantages of high-temperature plastic. Strength, toughness, ruggedness, erosion resistance, high heat capacity! But MIN-KLAD does more.

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lower than the molecular conductivity of still air! And this conductivity (already less than half that of the best Blower Insulation) drops still further with altitude. At 33 miles, for example, it is decreased by as much as 40%, with further decrease at greater altitudes.

Wide range of applications

MIN-KLAD offers the missile and rocket designer a rich choice of heat-control possibilities. It may be used for a part that must insulate, yet lose the structural advantages of plastic. Where requirements call for a soft, unobstructed insulating surface... or for a good adhesive bond between MIN-K insulation and other surfaces. Or, it may be used to control high-temperature

temperatures! For high heat capacity of asbestos-reinforced plastic combined with the low conductivity and heat capacity of MIN-K result in a product that provides maximum heat transfer under transient conditions.

MIN-KLAD is now being tested for approximately two dozen missile and rocket designs. Why not investigate this new material for your present thermal requirements? Upon request, we'll be pleased to send you a sample of the material along with detailed technical information. Write: Johns-Manville, Box 14, New York 30, New York (Ask, too, for information on MIN-K insulation and the new system insulation known as MIN-K-255.) In Canada: Fort Credit, Ontario.

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North American X-15 research plane is mated to wing of Boeing B-52 jet bomber in preparation for test flight at Edwards AFB.

Wing Pylon Secures X-15 Research Plane to B-52



Hydraulic boom secures X-15 to the B-52's right wing pylon (left). Boom stands clear from wing (right) as used for final positioning. Wings are covered with protective covers. The X-15 around silhouette structure from after the attachment was made (AW Feb. 2, p. 26) is detraction compatibility between the two aircraft. Finagle straps have propelled and control lines.

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Man Without Fear

Adapted from David Reardon

his total kills to 47 in less than 3 months of combat flying on the Western Front. That exploit was Canada's Billy Bishop the Victoria Cross

Armed only with two rifle-caliber machine guns, Bishop showed the world what a fighter pilot could do with a 113 hp. plane that had a top speed of 107 mph. In less than six months, he fought 370 air battles and scored 72 victories—25 of them in just 12 days. As a season of only six weeks at the front, his once engaged 23 different enemy aircraft in a single day.

For his bravery in the war, Toronto-born William Avery Bishop became the first man in military history to receive the British Empire's three highest decorations in one ceremony. He was then 23 years old.

Luke Germany's Baron von Richehofen and other sons of the war, Bishop-based mad. Early in 1917, he left the Canadian Mounted Rifles to join the Royal Flying Corps as an observer. In March he became a fighter pilot. Unlike the Red Knights of Germany, who wanted for the entry to come to him, Bishop was a rider. His French-built Nieuport biplane became the wings of the shot over the Western Front.

Bishop relied on Corporal Walter Bourne, a conscientious British mechanic, to keep the Nieuport - particularly its temperamental LeRhône rotary engine - in fighting shape. He owed his life and limb to Bourne's sound sense of humor. The Nieuport was introduced in the Western Front in 1915. Bishop and his fellow aviators found the plane highly maneuverable, despite its tendency to shuck its wings in a steep dive.

The Canadians are accused of killing 47 Indians in Nicaragua before he was ordered on a tour of recruiting duty in Canada and the United States in the fall of 1917. He later was ordered to set up a fighter



quarters, and in June, 1918 the General Staff ordered him to report to London to begin reorganization work on what was to become the Royal Canadian Air Force. In the 12 free days he had left before reporting to London, Colonel Bishop went hunting in the skies over eastern territory. He brought down another 25 planes.

Bishop was never wounded in the war, nor did he have an aircraft accident—a remarkable record in itself. He returned to peacetime life unaware that he would be back in uniform 21 years later—as a full Air Marshal.

Until Bishop's death in 1956, he maintained a close friendship with the frame-liner mechanic, Walt Bourne. When he was buried in Tacoma with full military honors, a dozen jet-age fighter planes from the air force he inspired dipped their wings in homage to Billy Bishop—the man who was without fear.

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of a missile



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The compact, self-contained unit shown here is Smith's new 8-sensor Triaxial Recording Accelerometer—so small it can be attached to a 1/4 in. radius mandrel nose section.

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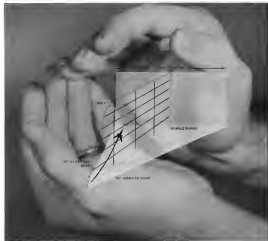
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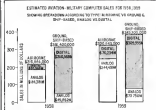
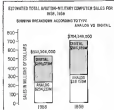
high-angle, multi-point climb-outs of jet aircraft have been achieved by the U.S. Navy, the U.S. Air Force and by Lockheed, Douglas, Convair, North American and Hughes Aircraft Companies in actual operation at Moffett NAS, Coast AFB, and at Palmdale Flight Test Center. Quadraradar's unique capability in providing an aerial command with accurate, safe altitude separation, coordinated TACAN approach, dual-mode scan altitude and multiple runway coverage. It is also used as a line-of-sight radar.



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AVIONICS



AVIATION WEEK survey of computer manufacturers reveals for the first time the size of the aviation-military market for computers and shows how market is divided between analog and digital type computers for airborne and ground/ship-based applications.

Survey Shows Size of Computer Market

By Philip J. Klaus

Washington-More than half a billion dollars worth of analog and digital computers were sold last year for the use of the military and the figure probably will exceed three-quarters of a billion dollars in 1959, an Aviation Week survey reveals.

The survey also disclosed how the market is divided between analog and digital type computers and between airborne and ground/ship-based applications. Results, based on responses from 32 computer manufacturers out of 57 queried, indicate potentials of the major suppliers.

Total computer sales for the 32 manufacturers for 1958 were estimated at \$335.5 million. For 1959, the figure is estimated at \$394.5 million, a 17% increase over the previous year. Total industry sales figures, including companies that did not participate in the survey, possibly run 10% to 20% higher—but this is only a speculative estimate.

Sales of Computers

Sales of airborne computers in 1958 were estimated at \$216.9 million, representing approximately 65% of the total. The remaining 35% represented ground and ship-based computers. In 1959, airborne computer sales are expected to climb to \$229.6 million and to account for 60% of the total, Aviation Week's survey, authored.

The survey revealed that digital computers now hold slightly more than half the aviation-military market, well below 1955 sales of \$299.1 million and

estimated sales of \$366.2 million in 1959. This is a substantial market for a device which only 10 years ago was little more than a laboratory curiosity.

Despite widespread development activity under way in airborne digital computers, the survey indicated that analog computers still constitute the bulk of current airborne computer production. In 1958, airborne digital computer sales were \$132.5 million for the companies surveyed representing 17% of the total \$216.9 million airborne computer market.

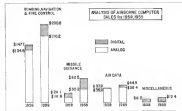
However, in 1959 airborne digital computer sales are expected to jump 33% to \$206.2 million, giving them a 90% of the total \$229.6 million.

and ground computer market. The 1959 airborne computer sales represent a 40% increase over total airborne sales for 1958, the survey shows.

In ground and ship-based applications, the digital computer already has taken a commanding lead over the analog type.

Of the total 1958 sales of \$335.4 million, digital computer sales of \$266.6 million represented 80%. Estimates for 1959 predict a 30% increase in total sales of ground and ship-based computers, for a figure of \$358.7 million. Of this figure, \$218.0 million represent digital computers, corresponding to 61% of the total.

Although this might suggest a slight



ANALYSIS of airborne computer sales, according to application and type, reveals that analog type still dominates current production but there is a trend to digital type computers.

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damage to the digital computer share of ground and shipboard computer production, encouraged by manufacturers suggest that this does not indicate a total lack in analog computers. A summary of total figures obtained in Aviation Week's survey, according to type of computer and application, is as follows:

	1958	1959
(Millions of Dollars)		
• Airborne Total	\$216.5	\$370.6
• Airborne Analog	\$184.4	\$241.4
• Airborne Digital	\$32.1	\$70.2
• GroundShip Total	\$116.4	\$555.7
• GroundShip Analog	\$49.9	\$73.5
• GroundShip Digital	\$166.5	\$182.9

Manufacturers were asked for a brief breakdown of estimated sales figures, according to end-use of the computer. For airborne computers, end categories listed were: bombing, navigation and fire control, missile guidance, air data, instrumentation. For ground and shipboard computers, four categories were: guidance and fire control, logistics, scientific, miscellaneous.

Airborne Computers

The survey showed that a substantial portion of current airborne computer production is going into aircraft applications, but the missile guidance portion is growing. Approximately 55% of total 1958 airborne computer sales at \$147.7 million, was listed under the category of bombing, navigation and fire control, while 11%, or \$21.1 million, was listed for missile guidance.

For 1959, manufacturers' estimates showed that bombing, navigation and fire control computer sales of \$208.5 million will represent 62% of total airborne sales, while missile guidance computer sales of \$61.5 million will have increased to 19% of the total airborne market.

Analysis showed that for bombing, navigation and fire control, digital computer sales top 9% of the total for this category in 1958, increasing to 14% in 1959. For missile guidance, digital computer constitutes 39% of the 1958 total for this category, increasing to 46% of the total for this category in 1959, according to the survey.

Air data computers (used to compute barometric altitude, speed and Mach number), represented a \$17.6 million market in 1958, with only 5% of this figure being digital types. In 1959, approximately 14% of the estimated \$44.9 million sales are expected to be digital types.

Of the \$275.1 million in ground and shipboard computers sold in 1958 for guidance and fire control, approximately 93% (\$182.1 million) were dig-

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Participating Companies

Following is an alphabetical listing of the 31 computer manufacturers that participate in Aviation Week's analog-to-digital conversion survey. AC Supply Corp. Division of General Motors, Airborne Instruments Laboratory, American Radio Audio Corp., Armegon Corp., Burroughs ElectroData Division, Collins Radio, Corbin-Wright Electronics Division, Erlang/Phone Division of Israeli Avionics, Eutronic Industries & TV Research Laboratory, General Electric Corporate Dept. Home Video Electronics Dept. and Light Military Electronics Dept., Gould MLE/Mechanical Division, Helicon Electronics Corp., Hughes Aircraft Co., International Business Machines Corp., Kallman Instrument, Ltd., Inc., Lull-Airtronics Laboratories, Matsushita Electric Corp.—U.S. Division, Raytheon Automatic Division, Sperry Data-Norad Co., Sperry Rand, Sperry Corp. of America, Thompson Radio Manufacturing Corp., Remington Rand Division, American Business, Inc., Sperry Gyroscopic Co., Standard Engineering Co., Westinghouse Electric Air Arm Division.

To encourage companies to participate in the survey and provide realistic figures, Aviation Week assured manufacturers that figures for individual companies would not be published or in any way disclosed.

and types. Sales in 1958 are expected to reach \$261.6 million, of which 38% are listed as digital.

All the logistics companies are digital, and gradually all the computer-based logisticians are also becoming digital. The latter figure does not accurately depict the situation because the largest manufacturers of analog computers for logistics are declining to participate in the survey.

In the manufacturing company, which includes such things as ground checkout equipment companies, approximately 90% of the \$53.4 million sales shown for 1958 are digital while 26% of the estimated \$69.4 million 1959 sales are listed as digital types.

Aviation Week's survey asked for manufacturers' comments on computer trends during the next five years, specifically on the number of analog vs. digital types.

One company commented: "Analog manufacturers will either have to build up a digital computer capability or merge up with a company that does have that knowledge through the group-buy approach."

Producers of all the companies surveyed agree that computer complexity will increase to achieve greater accuracy, computational speed and capacity. Despite this, nearly all of them expect use of new sub-state devices and micro-miniaturized construction.

Size and weight reduction of all these digital computers may also be expected through development and use of digital serving devices. This will maximize the trend for analog-to-digital and digital-to-analog conversion in the computer, several manufacturers say.

The trend toward airborne digital computers which combine general purpose and digital differential analysis techniques was forecast by several companies. Possible use of combination analog digital computers was suggested by another.

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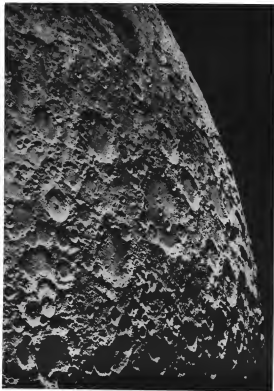
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*The Space Flight Division is one of the 7 divisions of Martin

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Expansions, Changes In Avionics Industry

General Electric Light Missile Electronic Department (LMBED) will construct a new 52,000 sq. ft. facility for its Advanced Electronics Center at the new Industrial Research Park, being established by Cornell University. The new structure, which completed in 1965, will house engineering offices and laboratories and is expected to employ 750-100 persons.

Other recently announced expansions and changes in the avionics field include:

- Texas Instruments Inc. has started work on a 192,000 sq. ft. addition to its general 110,000 sq. ft. Semiconductor Components Division manufacturing plant in northwest Dallas. Completion is expected within 12 months.

- Argus Electronics Inc., is the new name of the former Argus Program Co., Cambridge, Md., and Ft. Lauderdale, Fla.

- Radio Corp. of America has begun construction of a research and solar facility at Van Nuys, Calif. Initial construction will consist of three engineering buildings, an administration building and a manufacturing building with total of 220,000 sq. ft. of floor space. Occupancy is scheduled for late summer. Initial projects include waste treatment and launch equipment, solar radiation handling and radar systems.

- Bessmeyer Corp. will build a new 377,000 sq. ft. addition to its Tucson, Arizona plant in Arizona and plans to add 400 persons to the present 2,100-man force. Facility is used for company's R&D in defense and ballistic missile guidance computer work.

- Sprague Electric Co., North Adams, Mass., has purchased magnetic component and filter product lines of Hewlett Division of International Rectifier Co., Philadelphia. Sprague will produce magnetic devices and precision hand-pun filters at its Waukegan, Calif., and North Adams plants and will be sold under company's own trademarks. IRI's Hewlett Division will continue to produce precision resistors, which are not included in the transaction.

- Sybron Electric will open this month a 24,000 sq. ft. division headquarters and laboratory facility for its Electronic Systems Division in Waltham Industrial Center, near company's Waltham Laboratory.

- The O'Connell Co., Buffalo, N. Y., is a new company which will develop precision instrumentation, electronic controls and optical systems. George A. Reed is president. Company's address: 6310 Main St.

- Anasag, Inc., Detroit, has moved its entire manufacturing operations to larger facilities at 21935 Telegraph



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Road, but maintain general office and the engineering department at 12139 Telegraph Road.

• **Sears Corp.** of America will build a new 1,200,000 sq. ft. plant in Hicksville, L. I., N. Y., in which company will combine engineering, manufacturing and distribution operations now located in six plants. Occupancy is slated for August.

• **Kubatronics Inc.** is a new company which will develop and manufacture radar, communications, telemetry and microwave equipment. George E. Herold is president. Company address: 5915 Kuntz Ave. and 14512 Chesnut St., Van Nuys, Calif.

SYSTEM FILTER CENTER

► **Digital Voice Communications** New-Rencom projects its converting voice into digital (pulse-code) format and back, state voice suggests that digital voice communications requiring local outlets of the order of 110 cps instead of the conventional 3,000 cps may not be far off.

► **Digital Transducer Placement**—Contractor projects for digital transducers, capable of measuring voltage, current, temperature and other functions and providing digital type output without analog-to-digital conversion, are being evaluated by Wright Air Development Center's Weapons Guidance Laboratory. Use of direct digital transducers is expected to permit considerable reduction in size and weight of airborne digital computers.

► **New USAF Connector Spec**—Specifications for one octopole addition connector, slated to become Air Force standard, will be submitted shortly for industry comments. Connector design is suitable for operation of frequencies up to 400C. New connector spec, which incorporates features from many of different manufacturers' designs, was developed by Wright Air Development Center's Electronic Computer Laboratory and Weapons Guidance Laboratory.

► **Reliable Drone Guidance** — Radar command system developed by Sperry Gyroscope Co. for use with QF-80 drones has tested up extremely reliable sound according to USAF. Air Force test average of nine out of three for every 75 minutes, due to failure of acoustic guidance system. One QF-80 equipped with Sperry system has accumulated 520 hr. flying time equivalent to 168 missions without loss of guidance due to malfunctions. System is an FM/FM extended system operating in UHF band.



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See IERC Absolute Design Handbook, Inc. 101 — Improved Type
Illustration Tube Shields, 101 — Jan. 15, 1961



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AERONAUTICAL ENGINEERING



COST STUDIES indicated that prices of optimum Army designs (left) and stripped model (right) would not vary drastically.

Hiller Studies Minimum-Cost Helicopters

Primary deterrent to adequately developed low overall cost helicopters is the present cautious policy of separate budget funding for procurement and research, according to a Hiller Aircraft Corp. engineer who has made a detailed study of factors of cost, wing development and manufacturing costs.

Bentley procurement and operating funds are authorized separately, a policy has developed at purchase of low cost and underdeveloped equipment which forces a continuing burden on operating funds which are "an immediate cash pocket," he notes. Higher operating costs in turn reduce the chance of new equipment being purchased, J. R. Nichols, Hiller Aircraft Corp. noted during the 17th annual meeting of the Institute of the Aeronautical Sciences.

Cost Translational

The way out of this dilemma is to permit translational of operating costs funds into the procurement budget, providing an incentive to reduce the former so as to provide additional money for development which would lead to more adequate equipment reaching the user, he claims.

Development costs, the Hiller engineer noted, represent the smallest percentage of introducing a new helicopter into the field. An insufficiently developed machine requires a substantial number of corrective changes as its life represents a very poor bargain, he pointed out.

According to Nichols, to date no helicopter has ever entered the field in an adequately developed state—the result being that all helicopter production programs are replete with corrective life improving, Chicago Proposal (ECP).



COMPROMISE configuration is more operationalizable (left) than conventional design (above, right) and is designed for single conversion from piston to turbine powerplant.

Estimated ECP Costs

ITEM	NO. ECP'S ANALYZED (Number)	AVERAGE COSTS (Dollars)	TOTAL NO. ECP'S	TOTAL COSTS (Dollars)
Researching	55	\$3000	145	\$435,000
Testing	35	1500	140	195,000
Field Studies	25	300	100	30,000
Service Costs	55	\$150	35, 504 km	\$8,215,000
Indicated Total				\$4,715,000

AIRATION WEEK, February 15, 1959



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HELIX STUDIES on new light Army reconnaissance helicopter proved extensive use of stainless steel and optimum performance types with component design possibilities, with proposed final contract made in type and arrangement of basic components to study various problems, weight, production cost and maintenance cost.

costs. A large portion of HCP's are, in fact, nothing more than a continuation of an in complete development program in an analysis prepared of helicopter HCP costs. He noted that such costs for a typical small Army helicopter were a \$1 million per unit in total for the "off the shelf" cost of development of the original design. And if costs of actual manufacturing, labor, supply system distribution, loss of weight reduction and maintenance functions and other of all related parts are added to these above costs, it is probable that the overall HCP program costs are as high as \$1.5 million per unit. Only corrective HCP's not growth potential HCP's have been considered to be added.

Cost aspects of new helicopter designs were developed during a Helix study of a two-place rotary wing aircraft to meet an Army Transportation Research & Engineering Command design competition for a new vehicle to replace an three-place Helix H-21 and Bell H-13 types.

While approaches ranged from what is considered to be an optimum two-place design with a gross weight of

1,687 lb. to a stripped-down, minimum-cost vehicle, those estimates being supported with an incomplete justification. Type H-21, one typical component, was more approximately variable than the minimum cost proposal and was developed specifically in a vertical axis from a piston engine to a turbine propeller.

Design Variations

In design of the various configurations, variations were purposely made in choice of type and arrangement of components, each class of component being evaluated separately, where possible, for relative performance, weight, production cost and maintenance expense.

In addition, there was some other factor considered. For example, some Army users believed that the pilot should not have to observe through a full field of vision in light of the pilot's seat. The seat should not extend outside the main rotor disk—rotating in power and pulled forward in these designs employing short tail booms.

A standard design was chosen to ex-



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Energy conversion is our business



Division of General Motors,
Indianapolis, Indiana

measure the effects of variables in speed, altitude, air pressure, and so on. The standard design represented a type that had never been used before.

Each of the various designs met the given minimum specifications—some with wide margins and some just barely the 1000 engine model. There were also wide margins in pilot workload, workload, and other non-specification items.

A standard design was chosen to measure effects of variables in speed, altitude, air pressure, and so on. The design represented a hypothetical new two-place configuration meeting all of the specifications and had one critical design feature, equipment and fittings. Then each of the specification variables were varied independently, these including engine type (jet or piston), fuel type, altitude or air pressure, rotor blade design, workload, life, equipment, layout, cockpit, maintenance and payload.

New Weights

At each of the specifications was tested a new minimum gross weight was obtained representing optimum design. An International Business Machines computer program was used in this phase of the study by Hiller.

Design and specification study results were converted to actual dollar cost figures. Some 34 separate costs were provided based on other blades, engines, transmissions, instruments, electrical and hydraulic equipment, dog tags and extras. Hiller even was factoring dependent fabricated composite cost built when applicable.

The study considered that all costs that occurred before production start of a fully specified helicopter should be defined as development costs, including engineering development, testing for the contemplated total quantity and manufacturing of production aircraft. In fact, the development cost is based on the fact that production helicopters cannot be considered to represent fully developed prototypes of individual production aircraft. They are built on production tools. First production helicopter would not be built as production tooling, but this equipment should be eventually fully developed by the time the last production aircraft is produced.

Number of production helicopters was determined in the course of the Hiller study on the basis of observation of previous programs. Hiller concluded that on the basis of planned procurement of 1000 helicopters, then approximately 12 test models would be required. This would be the case in procurement of a completely new design.

Overall development costs for the



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are used extensively in the training of U. S. Air Force and Air National Guard pilots. By firing rockets and missiles at target radar, the Radar Weapons Training System measures, measures, measures in three dimensions, the Air Force uses U. S. taxpayers millions of dollars and introduces a higher degree of realism into training than is possible with other more costly systems.

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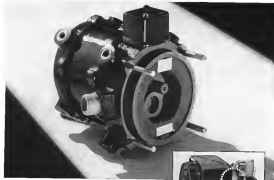
1. RADOP TARGET AREA — First to test a target out in terms of area, radar, and in fact, that required for the low phase to such as firing range.
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ages. Special features include magnetic couplings for weight savings, modified high temperature insulation and lubricants, and a special thermal overload protector (Type C protector) to prevent winding damage at temperatures above 400°F.

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Photo courtesy Walter Kilde & Company, Inc.

GENERAL ENGINEERING DATA

Airborne Special Design Motor 64442

1. 115,000 v-a-c, 400 cycle, 3 phase (overcoming to 100,000 v-a-c)
2. Rated 1.7 hp at 10,900 rpm—10 to 14 hp full torque 20 to 25 hp starting torque
3. Duty cycle: 30 min. on all full (on 400 v-a-c)
4. Ambient temperature: -40 to 400°F
5. Rotation: 1800 rpm
6. Weight: 6.5 lb

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ACOUSTIC-SEEKING capabilities are being tested by Alouette II, shown being off, strength is being tested in flight.

Alouette Demonstrates ASW Capability

By William S. Reed

Aboard USS Latham—Use of helicopter to bring Navy's destroyer submarine warfare hull potential up to snuff was capability was demonstrated here in a series of operations today. Project DASH for Destroyer Anti-Submarine Helicopter, conceived by the Navy as an interim measure pending development of advanced amphibious warfare (AW) systems, brings the multi-bowl division of extending the useful life of a World War II vintage destroyer fleet.

Destroyers always have had to "run over" submarines to drop depth charges or torpedoes. Now, faster submarines with increased underwater speed can evade attack even though destroyer warpage is greatly increased. Employed in DASH, Republic Association Corp's Sea Aircraft II (AW Sept. 1, p. 18) resembles the hull of a destroyer in general of a submarine anywhere within war zone. Introduction of the helicopter for a deep-sea submarine is virtually impossible even on sloped's first indication of attack would be the explosion of an acoustic-seeking torpedo against the hull.

Destroyer can be converted to



CERTIFIED for dual hull operation, Alouette II is hoisted from ship's deck.

The PLANE

New Douglas DC-8 Jetliner, soon to enter commercial service with 18 of the world's leading airlines. The four-jet DC-8 cruises at 560 to 590 mph, carries 118 to 176 passengers, and will cross the Atlantic non-stop from New York to Paris in just over six hours. Fuel capacity on international flights exceeds 21 thousand gallons.



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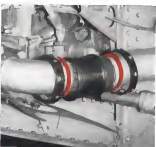
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Jet Fuel JP4, 15 days @ 250 F	30

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DA801 capabilities in 45 hr, according to the Navy, and already carry the necessary sensor gear for advanced detection, and radar and under gun sensors to direct the helicopter. Attaching two-deck masts to the deck and modifying the limited guard rail so that it folds is about all that is required. The Monette has been FAA certified to operate in Bushmaster Artemis II B1 cruise engine on the same diesel fuel used by the destroyer engines according to Republic, making it unnecessary to carry any extra jet fuel besides on the ship.

[illegible]

REPUBLIC Alcantara's smoke lying capability is obtained by pumping chemicals directly into the bakings. Now it's testing materials to make the smolder resistant to water.

lead, is in the vicinity of 75 mm; as
Tishchenko is concerned, the blow-out
would be complete all-weather caps
below.

Republic also demonstrated the Sea Dragon, a helicopter considerably smaller than the Alouette. Unlike Alouette, which has its rotor geared to the turbine, Dragon expels the exhaust from its Turbomeca Pallette IV into the

The ultimate in DASH would be a drop-type helicopter. Some estimates of the weight acquired for landing run as little as 300 lb. Significant beyond the increase in payload, decrease in size, and the operability of such a device, note how and cut through hollow blades to tip exhausts. DASH actually can lift a payload approximately equal to its own 500 lb weight according to Republic and has a surprisingly rapid drop-off rate.

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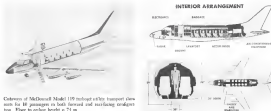
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Cabinets of McDonnell Model 119 turboprop entry transport show seats for 16 passengers in both forward and aft-facing configurations. Floor-to-ceiling height is 71 in.

McDonnell 119 Has Varied Cabin Configurations



Exploded view of McDonnell 119 seats in U.S. Air Force UIC configuration (AW Feb. 8, p. 12) emphasizes wide use of multiple tool paths to produce structural safety as fast as design. Fuselage rings are 30 in. apart and stringers are 6 in. apart, each stepping design built inside when they reach fast pace of structure. View at right shows arrangement for solar operation training aircraft.



Model 119 is presented with fixed air from Westinghouse J14 turboprop engines later, Pratt & Whitney JT12 engines will be installed. Configuration at left shown up at 12 ft. Another arrangement (right) includes use of dorsal and floor and aft wing.

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FINANCIAL

Report Pessimistic on Industry Outlook

New York—Finneman plans a pessimistic note in the 1959 outlook for airlines and aviation manufacturers contained in National Airlines Corp.'s annual report. The pessimism of this aviation company is primarily aviation and airline outlook.

After criticizing the Civil Aeronautics Board for acting too slowly in the fare increase fight and the airlines for their lack of assurance, the report adds:

"The fact that it seems logical to look for an 1959 in enough recovery as in (the airline industry's) standing in the capital market so that its equity base can be broadened without further dilution of the level which some of the traders were forced to impose on their shareholders put to rest all."

Noting the fourth quarter rise in airline earnings, the report also points out these looked better than they were because of the state situation. Still, it considers evidence of a continuation of traffic growth a heartening sign through its prediction of "a very strong" 1959.

"Having been denied the opportunity to put it on its knees during the 1950s," the report said, "the re-emergence of the post-war state and the added capacity which must be sold represent a significant undertaking in addition to a credit structure that has been stretched to its utmost limit."

Though pessimistic in the long run, National on the balance did increase its airline holdings last year in line with a trend that has generally been followed by professional investors (AW Oct. 6, p. 18; Jan. 13, p. 47). In some extent the trend may have been reinforced by (a) the fact that the theory that what has come down also must go back up—like a report from Bode & Co. issued about the same time as National Airlines Corp.'s summary gives a good insight as to how the market analyzes the situation.

Jet financing problems and reduced earnings a year ago depressed airline stock prices. However, the last substantial move then, but the Bode report notes that prices are still well below former price-earnings ratios, reflecting investor dissatisfaction with airline stocks, and this may still be selling at low prices in relation to potential earnings power.

The report cites three favorable factors:

- Traffic growth apparently will result with introduction of new equipment and services from the airlines. However, the Bode report considered tipping of this outlook vital.
- Equity dilution, the first of which was a major discount in stock prices in 1958, was not so severe as feared because of unexpected leniency on the part of institutions in arranging debt financing (AW Dec. 15, p. 37). Debt was still a deterrent for many carriers, heavy debt commitments may handicap

earnings, and severe restrictions have been placed on working capital and dividend payments in many cases, the report said. But the re-emergence program was deemed essential for growth of the industry.

• "More lenient" policy of the Civil Aeronautics Board in allowing a general fare increase, reduction of some discounts and jet mailings rate indicate a significant shift from the previous CAB trend that no one has been made for a rate increase.

The report recommended United Air Lines, Delta Air Lines and Continental Air Lines, the latter as a highly speculative situation but with considerable potential. Several others appeared at the report, the report said, naming American, Northwest, Capital (a special line on further air service) and Western. Trans World Airlines may be forced into further equity dilution as its financing plans mature, the report said, and Northwest, Eastern and Western are facing problems of intense competition along coastal routes.

Formerly of the line manufacturers—Boeing, Douglas, Convair and Lockheed—were no building the U.S. turbine transport for the next decade as based up on the situation.

"As matters stand today," the report said, "not one of the four builders has enough orders in hand to begin what has been involved in the design, development and testing of its first jet



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After its conception of a Moch 3-5 supersonic passenger transport was prepared by Convair Division of General Dynamics Corp., Aircraft would enter at a rate of 10,000 ft. in flight, according to design report by R. C. Schick, Convair vice president (AW Feb. 2, p. 38).



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adhere. Their combined investment in just this phase is in the order of \$500 million and has been written off in one year.

"However, to attract it in full scale is a tremendous venture, a high degree of security will be called for and the initial step of acquiring time facilities is an example."

Despite their reluctance to enter the area as principals in the depend of more equipment, the report and other monographs have recognized that a collapse in the steel plate market would still get into and have been to each other's aid in the end.

The report continued the Administration for its completion in the middle and upper field in face of Russian new policies. Placing a ceiling on defense spending when there is a question of its adequacy is a calculated risk, it will not be taken, the report stated.

Favorable developments mentioned in the report included:

- Establishment of the Federal Aviation Agency.
- Increase of the Chrysler report, bringing into focus public the push him of the airlines.
- Continued strength of the business during field.

Changes in the corporation's policies for year included:

- Eliminated: Brady Aviation Corp., KLM Royal Dutch Airlines, Northeast Airlines.
- Added for last year: Aspen Corp., Grumman, Hawker-Pfister, Helicopters, Lockheed Corp., Lockheed Aircraft Corp., Sikorsky Helicopters, TWA, Virgin America, Northwest Airlines.
- Increased personal holdings: Acrop General, General, North American Aviation and American, Boeing, United and Western Air Lines.
- Increased personal holdings: Boeing (after by purchase of Boeing convertible debentures), Boeing, General, Martin, Thompson, Ryan, Westinghouse, United Aircraft, Raytheon.

Market value of the total portfolio now given at \$12,459,572 compared with an average net of \$18,775,744.

Maneuver Plane Need Remains, Peale Says

New York—United States air defense philosophy is moving toward a "maneuver" Air Force which will continue current efforts to improve its status, according to Wm. I. Peale, president of Republic Aviation Corp.

He said he "tends to favor a 'maneuver' on the proportion of aircraft to missiles, but he is opposed to the New York Society of Security Analysts have last week that "there will always be need for manned aircraft."

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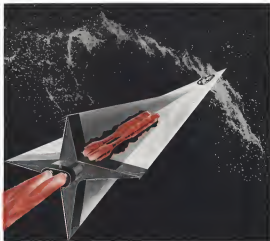
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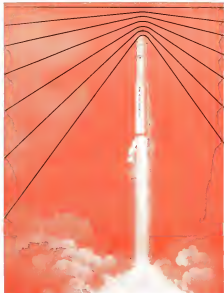
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vehicles, whether they be aircraft or space vehicles."

Poole noted that in developing missiles, "we must remember that we face the exceedingly difficult job of trying to duplicate the human skills of a pilot with mechanical, electronic and other control devices. In my opinion, we will never completely do this."

Poole also cited the rising cost of aircraft compared with the "excessive" cost of missiles. He claimed that, in production quantities, one advanced missile looks like a mere song may cost \$1 billion.

Discussing Republic's financial picture, Poole said the company has a current backlog of \$42,000,000 and said indications now are that Republic will later negotiate contracts to carry production through 1982. Republic F-105 Thunderchief jet interceptors is projected for production through 1983.

He estimated Republic sales for 1978 will be about \$201 million, net income, based on preliminary figures will be about \$5 million, with earnings per share about \$1.70, against \$4.35 in 1977. Poole predicted that in 1978, although productivity will increase, sales will be lower, explaining that this is due to "accounting treatment given to different type contracts."

The company will move from a cost plus fixed fee to a fixed price basis, receiving sales and earnings only upon physical delivery of aircraft, as indicated with progress bills and reimbursements made on cost plus fixed fee contracts.

Republic's working capital at the end of 1976 stood very much at \$16,018,000, at the equivalent of \$24.45 a share, working a hole of some \$1,130,000 in working capital during the year.

Defining the F-105 as "the most versatile weapon system ever devised,"

Poole said the emphasis is constantly being changed and expanded to improve design... "perhaps... introducing further into the future." He continued: "When we reach that inevitable point of saturation, we have plans for second and third generation F-2070... which now sounds like two engine STOVL and VTOL systems, a strike/scan version, a multi-targeting intercept version for the NATO countries."

Turning to Republic's declassification program, Poole said the Missile Division should show about \$6.4 million in sales for fiscal 1978, a year in which it doubled its business. He pointed out that the division this year will build experimental versions of the Shuttle spacecraft down in addition to service test production work on the SD-1000 project design data.

Republic, he noted, also has conducted comprehensive study of an anti-ICBM missile and an anti-satellite mis-

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side along with other sophisticated projects.

In the helicopter field, the idea of the Sud Alouette II isn't "just easy come by," Profile mentioned. The difficulty is not with the product, he explained, but in the right financing position of operators. Republic is taking "a long serious look" at the Sud Model 3100 triple-engine helicopter (AW Dec 20, p. 25) which Profile said has potential for local investigation and contractor service operations.

In the research and development field, which has \$45 and has increased for Republic's civil program, between \$5-13 million will be spent this year, mostly in construction and outfitting of the new Engineering Research & Development Center on Long Island.

Profile said, in reference to Republic's R&D and space technology efforts, "an extremely keen sense to be an organization that was a sudden do-or-die decision in our part." Generally, he said, the program simply reflects long-standing company policy of "keeping on top of rapidly changing technology."

- Projects include:
 - Studies on practicality of establishing a manned observation post on the moon.
 - Complex feasibility for determining proper trajectory for a lunar probe which has been worked out by Republic scientists.
 - Study programs on hot air, oxygen, hydrocarbon, and protective coating to withstand Mach 5 re-entry trajectories.
 - Research for a manned hypersonic bomber for Strategic Air Command.
- Republic Profile noted, also has three considerable development work on strategic orbital re-entry vehicles for the period between 1960-70, on earth-relying boost-plate is capable system, plus a proposal to put a man in space and return him safely.

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Wright-Patterson AFB—Olin. Following is a list of subcontracts for \$25,000 and over as released by the Air Materiel Command.

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cor delivers a note to the Soviet Ministry of Foreign Affairs, and the American Embassy in Moscow early approaches the Soviet Foreign Ministry, along for one week, information regarding the plane and its crew of 17.

Sept. 8: The Soviet Foreign Ministry early informs the American Embassy at Moscow that the Soviet authorities are checking the investigation requested in the Russian note of Sept. 8 down to know in what stages the plane could have approached the Soviet border. In response to the embassy's question, the Ministry states that the Soviet authorities have no information about the plane.

Sept. 12: The Soviet Foreign Ministry delivers a note to the American Embassy at Moscow, in which it is stated that a USSR aircraft has been found 50 kilometers south west of Yuzovsk in Soviet Armenia. The note further states that reasons of border control "from which it is possible to assume that no members of the plane crew perished." The note charges a deliberate violation of the Soviet border. In answer to this question, put by the United States Charge d'Affaires, Richard H. Davis, the Soviet Foreign Ministry states it has no further information to tell that goes on in the note. The Charge d'Affaires responds that a border search for the missing men has made, that an effort at the embassy in Moscow United States has been positioned to visit the crash site of the plane and that arrangements be made for the transfer to American authority of the remains of the air crew members mentioned in the Soviet note.

Sept. 16: The American Charge d'Affaires in Moscow delivers a note to the Soviet Foreign Ministry, requesting information as to the whereabouts and conditions of the 11 missing men, stating that the United States expects full cooperation from the Soviet government in providing access to the remains and in returning them. The note also requests that representatives of the embassy accompanied by technical experts as may be required to investigate the circumstances of the crash, be invited to visit the crash site and that facilities be extended to them for effecting identification of the victims and arranging for the transfer of the remains to appropriate United States authorities. The note goes on to report the Soviet charge that the plane deliberately violated the Soviet frontier and states that the United States government is unable to understand the delay of the Soviet authorities in furnishing it with the latest information concerning the Soviet note of Sept. 12 or the oral demand of any information made by a Foreign Ministry official. It stresses further that the United States Air Force has information to the effect that the plane was intercepted by three Soviet fighter aircraft in the region of the Soviet-Turkish frontier, that following the interception the plane proceeded toward Moscow for the control of the Soviet aircraft, and that shortly after the crash it was heard and a large column of smoke was observed rising at a point within Soviet territory. Finally, the note demands complete information regarding the circumstances involved and following the investigation. In answer to a question of the Charge d'Affaires, the Ministry offered to deliver the note was delivered reports that the Soviet authorities have no further in-

formation regarding the missing men.

Sept. 15, 16: The American Charge d'Affaires in Moscow, Richard H. Davis, asks Acting Soviet Foreign Minister Kuznetsov when a reply to the note of Sept. 13 will be forthcoming and if he has any further information on the missing men, pointing out the anguish suffered by the men's relatives. The Acting Foreign Minister replies that he has no further information, that a reply will be completed, and that these unpleasant efforts would be needed if American planes would stop provoking Soviet suspicion.

Sept. 17: Soviet Deputy Foreign Minister Fyodorov repeats the message given two days earlier by the acting foreign minister to the United States put by the American Charge d'Affaires.

Sept. 18: The Soviet Foreign Ministry replies to the American Embassy's note of Sept. 13. The reply states that the Soviet government has no information on the 11 missing crewmen and indicates the willing and the Soviet government to transfer to the American authorities the remains of any members of the crew found at the site of the crash. The note states that Soviet fighter planes intercepted the USAF C-119 on the west of the Turkish-Soviet frontier. The American Charge d'Affaires again questions the Acting Soviet Foreign Minister his information on the 11 missing men but is told that the Soviet government has no information about them. The Charge d'Affaires also requests the Soviet government officials be permitted to examine the wreckage at the scene of the crash, but is informed that this would not be possible. In response to a question the Acting Soviet Foreign Minister tells the American Charge d'Affaires that he has nothing to add in what is the only concerning the incident even regarding the crash.

Sept. 19: The American Embassy at Moscow delivers a note to the Soviet Foreign Ministry again requesting information on the missing 11 crewmen. The note also requests the monthly withdrawal of the remains and all members which will facilitate identification of the six living who are known to have perished.

Sept. 24: The remains of the six men are delivered by the Soviet authorities in Leningrad to the Soviet-Turkish frontier at the air vehicle of the American Embassy in Ankara.

Oct. 3: The American ambassador at Moscow hands to the Acting Soviet Foreign Minister a note requesting further information on the plane. The note reports the destruction of the interception of the USAF C-119 by Soviet fighter aircraft in the west of the Turkish-Soviet frontier and states that it must be assumed that the Soviet fighter pilots could not have knowledge of the circumstances surrounding the crash of the unmarked plane. The note states that in view of this the United States government cannot understand why the Soviet government continues to refuse to furnish information on the whereabouts of the crash or on the whereabouts and condition of the missing 11, stating that the Soviet charge that the C-119 violated the Soviet frontier, the note asks information on the crash and on the missing men, requests that the Soviet government be permitted to examine the wreckage at the crash site, and states that the Soviet authorities have the right to tell



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computation in the line of the search and its equipment.

• Oct. 6: In the course of a conversation on earlier work noted by the author, Deputy Under Secretary of State Robert D. Murphy requested Soviet Ambassador Novikov for information on the missing 11 crews and their crews by Treaty State, as dictated to the crash site of the C-130. The ambassador stated that the Soviet government has no further information on the matter and that since the crash site was probably in a restricted frontier area the United States was asking to visit a closed area in the Soviet Union. Mr. Murphy asked Ambassador Novikov to advise the Soviet government of his requests, asking that the United States has evidence that the C-130 was shot down.

• Oct. 16: Ambassador Novikov's Thompson's a headed a note for Soviet First Deputy Foreign Minister Gromyko, in Moscow. The note reiterates the statements mentioned in earlier Soviet communications on this subject in the effect that no further information is available and that the United States bears the responsibility for the incident.

• Nov. 4: The Air Force announced the abandonment of four of the crew members, also provided in the crash and whose remains were transferred to American soil on Sept. 24. The Air Force announced that the four crew members whose remains were not identified will be buried at Arlington National Cemetery with full military honors. The four crew members identified were:

First Lt. John E. Simpson, Richmond, Wash.
Capt. Keith J. Stevens, Compton, Calif.
First Lt. Ronald M. Villard, Lincoln, Texas.

Capt. Edward J. Jones, New Haven, Conn.

• Nov. 15: Deputy Under Secretary of State Robert D. Murphy returns Soviet Ambassador Novikov, who is accompanied by Mr. Gennadiy N. Kozlovskiy, an Article of the Soviet Embassy at Washington. Mr. Murphy presents the Soviet Ambassador with evidence that Soviet ships plane crashed the C-130 and that it was down.

• Dec. 7, 1976: Vice President Richard M. Nixon, during a conversation with Soviet First Deputy Foreign Minister G. Gromyko, said that the Soviet government gave the United States government an affidavit, a statement about what happened to the 11 missing crew members of the C-130. Mr. Gromyko replied that the Soviet government had given all the information it had.

• Dec. 14: The Secretary of State, during a conversation with Soviet Deputy Foreign Minister in the afternoon of Jan. 14, said about the fate of the crew of the C-130. Mr. Gromyko says that the Soviet government had done all that it could do. Mr. Gromyko denies that the plane had not been shot down.

Radio Transcript

(Following is the State Department's translation of the conversation among the Soviet foreign plane which the Department says are controlled during their attack on the C-130.)

I am at Washington speed . . .
Rogov:
What a point
1,300.

I and you carefully.
151, I read carefully.
I and 11 numberly.

Shkurovskiy altitude 160.

Understand.

In the northeast, about 7 bells here. (Soviet bells apparently refer to the clock here below the air craft. Soviet bells would mean 700, clock time.)

Very poor, almost none.
1,620

Rogov, 130.

151, I have taken cover 530, altitude 50.

Rogov, I am taking.

They are identified, altitude 80.

Rogov, 40. (Soviet)

... poor, I cannot see the observation point yet.

No, not visible, it doesn't matter.

... bad!

151, I have taken.

151, passed the second.

I am 250. I am on the lower left ("Tory") is believed to be a reference to the Turkish Soviet border.)

Rogov, passed in a slight climb toward you.

... altitude 100.

My course is 200.

Rogov.

Rogov.

... poor, I cannot see the observation point yet.

No, I am taking.

I am 250. I am on the lower left ("Tory") is believed to be a reference to the Turkish Soviet border.)

Rogov, passed in a slight climb toward you.

... altitude 100.

Rogov.

My course is 200.

Rogov.

... poor, I cannot see the observation point yet.

No, I am taking.

I am 250. I am on the lower left ("Tory") is believed to be a reference to the Turkish Soviet border.)

Rogov, passed in a slight climb toward you.

... altitude 100.

Rogov.

My course is 200.

151, I am attacking the target.

110.

250.

Target, altitude is 200. I am going along with it. I am towing toward the front.

The target is towing.

There's a hit.

The target is burning, 151.

The target is burning.

It is going toward the front.

... poor, I cannot see the observation point yet.

No, not visible, it doesn't matter.

... bad!

151, I have taken.

151, passed the second.

I am 250. I am on the lower left ("Tory") is believed to be a reference to the Turkish Soviet border.)

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Rogov.

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Rarely does a representative United Aircraft's stadium make available such key questions. And only those questions would be filed from within. Inside the other divisions (Prest & Henry, Sikorsky, Hamilton Standard, etc.) cannot spare a technical representative staff man. Those questions must be filed from the outside. They will wait beyond ordinary knowledge.

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52, how do you read me? I am 16
53, who don't you answer 30?
Rager, then a 577 talking to you
54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.



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The wing tanks have just now run out. What is your estimate of the Soviet jet pilot's position during the attack against the C-130? Course position indicated in the north, they are unable to drive in the radio transponder. The aircraft was sighted by a MiG-17 pilot.

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The expert fighting men of one of the aircraft divisions detected the aerial target. They did not know what it was or where it would go. However, they immediately assigned a mission to the target and it was not out of the way.

The operators of the aircraft, who are always on alert and know their job well, immediately prepared for work and attended to the situation.

Now the target appeared on the command post plotting board. It was played by the screen player, P-1. First Class Bonds checked who was in a position of readiness to conduct the mission.

The dog and dogfighting flight was recorded the course of the "game" with their pen and chalk marks.

Duty Officer Eshkov showed the work of the plotters. This officer has years of experience in being operations at the air bases of the command plane of the Soviet Union.

Flights had been completed only 15 minutes before the flight. The fighting team at the command post had to work for a period of 15 minutes.

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crisis hour. They were checking the line data of Atlas in the air, making adjustments as targets and long computing possible to make flight control easy for the commander. The next period did not last long. "The system chief decided to check our system," thought Mr. Kohnen, and looked around by lots of habit—all the operators were at their posts and ready for work. The first data which came in to the command post made Mr. Kohnen pick up his ear, the target getting ahead, was approaching the area pointed in the flight plan of an invasion. X.

The attack must be intercepted at maximum distance, decided the officers and entered the fighter aircraft to be ready.

The navigator, Capt. Katsuyuki, who had just came on duty, and the plotter were at the table working on the vector plotting board. The first cross bearing on the movement of the target were made by Fourier. Before, according to the data which he received from the operator, Juanito Sot. Cevallos.

The cross bearing appeared on the map in its specific time intervals. Next to them were later figures for altitude, speed and amount. After evaluating the air situation, Capt. Katsuyuki quickly made calculations for launching the fighter aircraft.

"OK, take off in a pair," ordered the officer. The reply: "There is a dust storm in the airfield. Takeoff is impossible."

This unexpected complication did not discourage the officers. He passed the information back again and commanded, "OK, take off in a pair."

Other fighter aircraft received this command. Shortly the engines roared and quickly the pair of jet fighter aircraft set off to meet the "enemy."

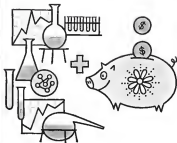
Some minutes later when the dust storm cleared, two more interceptors took off. Immediately new cross bearings appeared on the screen. The plotter, Pvt. Fushiro, started to work. Something in information which he received from the radar operator, Katsuyuki, the fighting was fast. There was a line for the flight course of the fighter aircraft which had taken off for interception, and then began to fire the target.

In the same room, Senior Lieutenant Commander Fushiro and Katsuyuki analyzed the situation on which they saw the highly illuminated screen of the plasma screen indicator. Local agents leader there in observing their fighter aircraft. However, they saw the target well and it was the vectoring navigator, Capt. Katsuyuki, concerning the character of the flight.

At all points the well trained fighting men are working on the screen of the radar set, in the air situation plotting board and in the vectoring table. Now all these things are directed at one thing—accurate tracking of the target, ensuring successful vectoring of the fighter aircraft and interception of the "enemy" in the latest approach.

By their harmonious coordinated efforts they are accomplishing one great task. Every fighting man knows responsibility and can correct his duties with great composure. Even here Capt. Katsuyuki although he was very busy, remembered the excellent work of the operator and plotter—the tracking of the target was reliable and without error.

The navigator's calculations proved to



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be precise, and the command found the confusion. Suddenly the fighter aircraft were approaching the indicated area. The lead-in was in the wake of the command post because of the point. It was necessary to direct the pilots into an aerial position where they could engage the enemy and to ensure mutual contact of the aircraft "team lead."

The long search of the command post was in full swing.

"Great Skill, Part II"

Combat readiness was maintained in the aircraft by side.

Fighter pilots officers Legation and Gorn, based in their aircraft around which technicians were working.

They did not have long to wait. The pilots had already taken their places in the cockpit, looked around and determined that all was in order when the command came: "501, take off in a pair." After take-off the fighter pilots entered a position to proceed to engage "X." A few minutes were needed to get in the assigned area. Immediately the leader of the pair, Senior 11, Legation, reported then to the command post where Capt. Romanenko was waiting and his duties at the following table.

Course 180, altitude 15,000, was transmitted from the command post.

Officers Legation and Gorn as a pilot in their third year of service. They have made only about six flight hours, for reconnaissance of aerial targets. They have earned the status of skilled fighter pilots by their persistence in studying techniques and skills and their attitude in flight.

Fighting was an, always, passed in less than half a second. Upon command from the command post they rose on each flight step, with speed and skill and put into it all their training, the remarkable power of man and the strength of all fighting men. On the day it was the same. The pilots passed out each command at the command post. They understood well that battle depends on the accuracy of the report depended on their coordinated and precise action. Course 180, 180, and about 180,000 ft in 180 ft, following down the Legation and his who was going to drive over the target. The enemy, maneuvered in, attacked, and changed speed. However, the fighting was at the side of the target, the target was at the side. From various places the various side moved from the side to the right of the target and the commander. Now, the pair of fighter aircraft was over the target.

With great precision, command Capt. Romanenko directed them down and down. Now he informed the pilot "the target is in front, to the right, below."

Upon the background of the winged silhouette, Legation's pointed eye noted the silhouette of the aircraft "I see the target" and the pilot.

Legation and Gorn, in a flash they were some distance apart, almost instantaneously thought that it would be necessary to "shoot" at the most vulnerable spot of the target.

The leader, Legation, dashed in to it, took aim and watched on his gun camera. After him, officer Gorn, dashed in the "shoot" and succeeded in making them

pass. When the target was in a position to see and back of the attack, the second pair of fighter aircraft entered the battle. These were Senior Romanenko, Romanenko and Roman. After them the first pair moved and another successful attack on the target.

501, take off in a pair. The pilots were not transmitted to the pair for security. The fighter aircraft had left, but and there might not be enough for the fight in three or four minutes. Furthermore, the sense that wanted to think the pilot personally for achieving a high rate of training and performance in intercepting the target. Several minutes later the fighter aircraft landed at the airport and the pilots. Legation and Gorn a little later when the commander got started out, the pilots returned together.

"That was fine," said Gorn, quickly just as an attack started.

"To be sure, the flight was intensive," commented Romanenko.

The ground crew was in the picture. It took five hours to take and the flight was the most successful mission of the mission. We were the best. Gorn, the officer, returned to the command post.

Several minutes later the commander flew over the ground. This time the fighter pilot landed from through steadily and remained with satisfaction. Good work! The attack was completed and rapid, and the target was destroyed.

The high evaluation of the pilot's action was evident that they would still be returning from flight to fight.

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Other top level positions are available in systems development, systems development, and related fields. Maximum requirements are actual experience plus B.S. or advanced degree in E.E. and Physics.

For more information, please write to Mr. A. B. Stevens, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

THE LOS ANGELES DIVISION OF
NORTH AMERICAN AVIATION, INC.



WHO'S WHERE

(Continued from page 21)

Changes

James W. Cline, director-international commercial and military sales, Douglas Aircraft Company, Inc., Santa Monica, Calif. Also Ronald A. Brown, chief assistant in the director, J. W. Cline, Douglas Aircraft Company, Santa Monica, Calif. Also T. Dwyer, South American sales manager (San de Antonio, Texas).

Lynne C. Jorgels, M., chief engineer aircraft, General Electric Aircraft, Inc., St. Louis.

Howard P. Mason, Pacific Missile Range base manager, Aerojet General Corp., Azusa, Calif.

R. J. Mitchell, commercial manager, The Torrington Corp., Ltd., London, England.

John C. Riedel, senior project engineer electronics, and Donald E. Lovell, senior project engineer electronics, Embury Corp., Providence, R.I.

John M. Ruffin, industrial sales manager, Ford, Inc., Ashland, Mass.

John J. Smith, senior project engineer, Test Equipment Division, Consolidated Diesel Electric Corp., Stamford, Conn.

George W. Chisholm, assistant manager research projects, and Electronics Products Group, Radar Radio Division of Bendix Aviation Corp., Baltimore, Md. E. D. Hart, research Mr. Chisholm is acting manager.

Edward Lutz, senior field engineer to lead Aerojet General Corp.'s field activities on the Navy Polaris fleet battles inside at Patrick AFB, Cape Canaveral, Fla.

William C. Woodward, manager aircraft and missile sales, Vought Company of America, Cleveland, Ohio.

Edward W. Manning, general manager, Military Electronics Company Division, Raytheon Corp., Dorchester, Mass.

John B. B. Baskins, electronic manager, Pacific Missile Division of Douglas Aviation Corp., North Hollywood, Calif.

Wendell Butler, Jr., staff engineer, Chrysler Division Corp., West Hartford, Conn.

William T. Bacon, assistant manager systems sales and Eugene E. Martin, assistant manager and senior sales, Electronics Division of Spaulding Corp., Rochester, N.Y.

Robert V. Burns, manager of the Los Angeles office of The Martin Co., Baltimore, Md.

E. R. Scharf, chief of the newly established Manufacturing Engineering Department of Autonics, a division of North American Aviation, Inc., Downey, Calif.

Dr. Douglas Dicks, technical advisor in space technology, Autonics, Inc., Melrose, Mass.

W. J. Chisholm, manager of field operations electronics, Autonics and Jetco Division, Autonics-Tyco Electronics Co., Anaheim, Calif.

Dr. Edward K. Wilson, director and chief of W. G. Gossard, associate director, Compton and Data Industries, Center of Space Technology Laboratories, Inc., Los Angeles, Calif.

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4. DESIGN ANALYSIS Requires engineers capable of performance analysis throughout preliminary design work leading to prepare and coordinate final proposals.

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Personal contact to: Mr. G. B. Beatty

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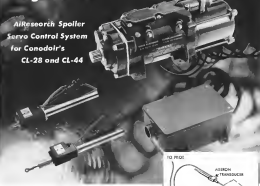
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Advanced electro-mechanical systems

AiResearch Spoiler Servo Control System for Canadair's CL-28 and CL-44

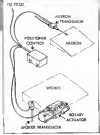


A substantial increase in aircraft effectiveness is achieved by the AiResearch Spoiler Servo Control System which regulates the position of the spoiler to increase the rate of roll of the aircraft. Full spoiler surface travel is achieved in 0.5 sec. solely by electro-mechanical checking of the H.P. power servo.

The added control system of the Spoiler Servo Control System operates on the inherent rate of each aircraft. This AiResearch electro-mechanical system automatically synchronizes the spoiler control system to meet any aircraft with the spoiler by sensing a magnetic amplifier and position transducer in the closed loop servo system.

This new Spoiler Servo Control System is but one of the many types of electro-mechanical systems developed and manufactured by AiResearch. Other systems available include: air-to-air combat, engine, navigation, engine, navigation and engine control systems, and various other systems.

The company's more than 20 years of experience in the development and manufacture of electro-mechanical systems extends into aircraft, ground-based, and air-to-air and air-to-ground systems. AiResearch's reputation for quality and reliability has made it a leader in the electro-mechanical industry.



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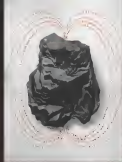
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MAGNETOHYDRODYNAMICS Lockheed is the *Aviation* Semiconducting in this important new field—which deals with the effect of magnetic fields on the behavior of fluids—efforted physicists from all over the world. This year, the existing centered in the investigation of control of high speed vehicles by magnetically inducing changes in airflow. As a part of the effort, there's related experiments in magnetic forces involved the use of the ancient technique—furnace of investigators and theories by scientists today into the magnetic forces of the solar prominence.

Lockheed Missiles and Space Division has complete capabilities in more than 40 areas of science and technology—from concept to operation. Headquarters are at Sunnyvale, California, as the San Francisco Peninsula, with research and development facilities located in the Stanford Industrial Park is nearby Palo Alto and at Van Nuys in the San Fernando Valley of Los Angeles. A 4,000 acre, company-owned test base, 40 miles from Sunnyvale, conducts all phases of static field testing. In addition, complete flight testing is conducted at Cape Canaveral, Fla., Alamogordo, N.M., and Vandenberg AFB, Calif., as an integral part of every stage of missile and space programs at Lockheed. The Division's advanced research and development programs now under intense study provide a fascinating challenge to creative engineering. These programs include: new in space; space communications; electronics; fission, nuclear and solar propulsion; magnetohydrodynamics; oceanography; computer research and development; operations research and analysis; human engineering; electromagnetic wave propagation and radiation; materials and processes and others.

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*Copies of the proceedings of the first two symposiums were published by the Stanford University Press, Palo Alto, Calif., and are available on loan. Results of this year's symposium will be published shortly by the same press.



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JATO ROCKETS boost Super 15 two-engine rocket ship to nearly 600 mph, by 100 mph, as one engine lifts airplane at full gross weight.

JATO Approved for Super 18

First business supplier of under 10,000 lb. gross weight to be fitted with FAA-approved factory-installed standby rocket motors for emergency use, has been delivered by Beech Aircraft Corp. to Weyhehmer-Timber Co., Tacoma, Wash. Delivery followed development of the installation and an extensive flight test program at the aircraft manufacturer's Wichita, Kan., plant on the Weyhehmer-Timber Beech Super 18. Installation of the new Aerojet-General 158G 150 "Junior JATO" rocket motor, installed behind each of the airplane's 478-hp Pratt & Whitney R3600-AN140 piston engines, showed following results during tests:

- Increase of 900 mph in single engine rate of climb, with airplane at full gross weight.
- Increase of 575 mph in rate of climb rate of climb with airplane at 7,600 lb. weight.

Beech currently has a backlog of eight additional Super 18s to be fitted with the Aerojet-General 158G, three JATO rocket motors, a company spokesman told *American Aviator*. In addition to providing factory installation, the company is also developing a kit which customers may have fitted to their Super 18s in the field. The rocket motor is offered as optional factory-installed equipment at price of \$2,850. Kit will be considerably under this figure since installation cost will not be included.

When fired simultaneously, the Junior JATO motors add approximately 100 hp each to the Super 18's piston engines to provide a considerable extra safety margin in event of primary power loss on takeoff or any other emergency for instantaneous power increase exceeding normal engine performance.

Approval of the installation of the



ONE SWITCH (left) fires both rockets at once.



Motor is placed in engine compartment.

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WING TIPS



FAST ISN'T RIGHT. When refueling your plane with regular, it's a good idea to leave a little slack in the hose. Otherwise, if they get wet and contract, they might pull too hard on

the aircraft's structure. A serious damage deal might go undetected. Many planes are now being insured with light claims to eliminate this hazard.



PROPS. Esso is one of the world's major suppliers of jet fuels. For America, America and many other airlines also use Esso Turbo 560 to lubricate their jet engines. Esso Aviation Fuels help all planes — large or small, prop or jet — get top performance. You can depend on Esso Aviation Fuels to give your plane's engine the instant jet power and economy.

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Piper, Cessna Gain

Gains in the volume in the last quarter of this fiscal year are reported by Piper Aircraft Corp. and Cessna Aircraft Co.

Piper notes a 58.4% increase in sales over the same period last year, says for the three months ending Dec. 31, 1968, totaling \$7,482,318, with net income being \$196,800 an increase of 13.4% over last year's total quarter.

Cessna notes sales totaling \$20,536,000 for the first quarter, ending Dec. 31, compared with \$20,772,000 in the same period last year.

Piper expects further increase in sales without meeting final step-up in first quarter. Despite production in first one to command-hold a day in January. This spring Piper will introduce its 180-hp, plus turbo light twin business plane and will schedule two engine plane production for two per day in the balance of the year. For this calendar, the company will begin production of its Pioneer experimental plane. Output of Cessna four plane business plane is looking fair at last per day.

Cessna expects that 1969 commercial aircraft sales should exceed its record breaking 1958 volume, and also expects profits of its subsidiaries, Aircraft Sales Corp., to be markedly higher this year than in 1968.

ally on other side of the fuselage, behind the cockpit. In addition, the Altair also featured a \$1010. sales, conspicuous bags of concrete 600-lb rolls of cable and other equipment for the installation of the 42-ft. housing for a water measurement station erected by the Chileans.

Department of Water Resources. Only overland access to the coast was a steep and narrow path which prohibited movement of the material.

During construction of a complete Park Service fire lookout station built near the top of 18,450-ft. Mt. Washburn in the Sierra Nevada range, the Alameda flow factor from the promised one-ton-per-hour of 25,000 lb of building equipment and supplies. During the operation the first field was moved from a spot two miles away from the look-out to another field 15 mi away. First construction team were also ferried back and forth from a bus station at 7,500-ft. altitude.

Tasks during this project included whole prefabricated roof and wall sections, correct lumber, building tools, a compressor, stove, refrigerator and kitchen sink.

In addition to buying supplies the San-designed twelve-powered helicopter flew a series of five missions carrying seven tons of living per day during a five-day period.

Airlift carried four tons a trip in addition to 750-1000 lb of equipment, Tumble reports.

Soon after the National Park Service found Alameda to open a 100-acre patch of high-level soil near the crest of the Sierra near Yosemite National Park. Occupying at 9,400-ft. altitude, the aerial spread a total of 1,800 gal. of the soil, averaging one and a half acres in an acre. Built previously, team with other helicopter types was about as new in an acre, Tumble states.

The Alameda was fitted with two specially designed tanks capable of carrying up to 50-gal. a trip.



Umbough Signs Production Agreement

Contract for production of Umbough Model 18 prop plane \$30,000 entry wing aircraft has been signed with General Aviation Corp., a subsidiary of General Aviation Corporation business plane. Initial production unit is scheduled to leave General's line this month. Umbough reports that 4 Super to have 1,000 built in October of this year. First week 1000 prop, Umbough 10 ft. and to have come speed of 180 mph. at 55 ft. power and maximum endurance of 45 ft. with normal fuel load of 50 gal. Maximum gross weight is given at 1,000 lb. length is approximately 23 ft., height is 16 ft. 6 in. First spring; sales possible month with 10.

work in the fields of the future in 1964



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Forward resume of exp. as engineers for your personal interview can be made. Write to: Mr. J. L. Bann, Engineering Personnel Administrator, Dept. 73-6. Selection agencies paid in qualified applicants.



GLIDING UP Cowl is 1959 Cessna Skyline, priced at \$17,091, boasts speed 100 miles per hour. Cowl features standard nose up.

Cessna Raises 1959 Line's Price

Aerodynamic cleanup and revised interior mark the 1959 models of Cessna Aircraft Co.'s "right, middle line" of business planes—Skyline Model 182 and Model 180. Changes have resulted in slight performance gains for Skyline and Model 182.

Increased power is also evident for the 1959 models of these four-place business planes. Skyline is now priced at \$17,091 compared with \$16,550 last year. Model 182 is listed at \$16,600 compared with \$14,150 previously and the Model 180 now sells for \$14,275 compared with \$11,950 last year.

Menor and cover speeds are assumed two miles per hour for both the Skyline and Model 182. Gains not achieved primarily by redesigns of the

forward fuselage area and engine cooling. Cowl features a new, more streamlined nose cap and lower cowl is designed to provide better lifting around the nose-wheel strut. Right cowl access door has been eliminated to provide a smoother air flow.

Cowl redesign provides improved air filtering system, Cessna reports. Cabinizer air filter has been moved farther in the nose cap to provide a diversion in coarse and improved accessibility. Air induction system has an adapter duct for delivering filtered air to the cabinizer from the filter. Duct is attached with the lower cowl and is attached to the cabinizer air box. Intake for cabinizer air source has been moved above the engine intake duct cowl for additional

protection from dust. Cowl flaps are installed to provide cooling during take-off and climb, flaps being operated by a push-pull control in the cockpit.

All three models have 130-hp. Continental engines with new four-throw pistons to enhance service.

Wing strut flaps have been made standard equipment on the Skyline, a back to the de-ice heated wing system of the Model 182. Flaps are of flexible tie-down fitting. Skyline and Model 182 now are fitted with a single prop and assist along conventional approach 182 inches ahead of the leading gear landing edge.

Forged upper and lower door hinges replace former steel stampings; the new hinges were installed to provide increased rigidity and better sealing of door to the fuselage. Upper hinge is additionally strengthened by use of a decaurate web.

All three airplanes have a redesigned instrument panel providing shock-mounted instrument group in front of the pilot with controls for navigation and flight instrumentation; engine instruments are placed on a sideboard. Instrument panel instrument of fuel gauges, oil pressure and oil temperature gauges above the glove compartment on the right side. Fuel has provision for two engines and an APU along the top center, with space above the center-mounted radio for installation of Van Air's Levelair T-1 T-2 or T-3 into standard instrument compartment.

Laterals in the instrument panel are enclosed under a steel panel and both screws clamping used for mounting nuts from the rear of the instrument when it is taken from the panel.

Tilting front seats are now offered in optional equipment. The seat back being hinged to the seat bottom so that the back reclines when the bottom is raised to the three adjustment positions.

Skyline top speed is now 170 mph. Cruise speed is up to 168 mph. Range at maximum cruise has been raised from 667 to 675 mi. and maximum range is increased from 573 to 585 mi. Model 182 cruise and top speeds have been increased by Skyline figures. Range has been raised from 585 to 595 mi.

New Customs Ruling To Ease Border Flights

United States Customs Bureau is issuing instructions to its officers along the Canadian border easing clearance problems at outgoing commercial charter and air taxi operations.

According to a letter sent Nov. 10, 1958 from L. B. (R. D.) to the Acting Commissioner of Customs, questions may be presented to clear flights into Canada by telephoning the nearest cus-



INSTRUMENT PANEL has instruments grouped, Extra Levelair is mounted top center.

Hughes in Southern California

announces the establishment of

a major new division . . .

the COMMUNICATIONS DIVISION

The growing importance of global and space communications, together with major contributions of the Hughes Communications Laboratory, such as the Long Arm and Quickilver programs, has resulted in the creation of the communications division of the Hughes Aircraft Company. The new division is fully integrated and will be responsible for communications research, development, manufacturing and sales. Expansion plans are ambitious and aggressive, and the backlog of contracts already awarded promises an expansion consistent with the spectacular awards established by the other major divisions of Hughes Aircraft Company.

The establishment of Hughes as a major factor in the communications industry has created many

opportunities for experienced electronic engineers in the following areas:

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also
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Test Engineers

For further information write Mr. John McElvite at the address below.

HUGHES

COMMUNICATIONS DIVISION, P.O. Box 90-002, Los Angeles 45

most office plans to depart and filing by and the outward general declaration for the aircraft. This policy will apply when the characteristics in carrying passengers for hire but no cargo, or in shipping without passengers or cargo in order to pick up passengers in Canada. This will simplify procedures for operators who are not licensed to fly U.S. customs offices along the border. In the past the required documentation had to be delivered in person by the charter pilot to the customs inspectors before leaving the United States.

In the case of one operator that prior requirement meant flying 200 mi. additional to the outgoing paper and could add up to \$45 to the trip.

PRIVATE LINES

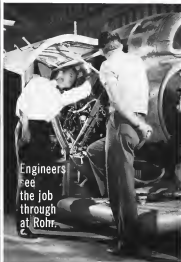
Manufacturing and sales rights to twin engine, four-seat Republic business airplane have been acquired by Effen Aircraft Manufacturing Co., Kansas Air Base, Topeka, Kan. P. H. Burns is president of Effen.

Two-seat lightplane, powered by a 91 hp, Lycoming engine, has been developed by Ron Arnold, Fitchburg, near Rochester, Vermont, for use by flying clubs. Cruise speed of Rg-6 is 118 mph. Span is 34.47 ft., length 24.99 ft. and empty weight is 3,452 lb.

Nominations are sought by the Women's Aeronautical Assn. of Kansas for its annual Distinguished Flight Safety Award to be presented this fall at the National Business Aircraft Assn.'s 1979 forum at Minneapolis, Minn. Sterling silver trophies are given each year to the person who makes the most outstanding contribution toward improving business flight safety and making it the safest means of travel. Deadline for nominations is 1979, together at Mrs. L. Women's Aeronautical Assn. of Kansas address is: P. O. Box 1676, Wichita.

General Aviation Council is now seeking for former General Aviation Facilities Planning Group, a voluntary association of 11 business and general flying groups, outside beyond to provide information on general aviation for President Eisenhower's special aviation assistant, Edward P. Corbin. Chairman of the new council is Joseph B. Burns, Joseph V. Corbin, Jr., is secretary-treasurer.

Survey of how airplanes are used in Michigan will cover some 3,500 aircraft owners. Initial portion of survey will cover personal planes; second part will deal with business aircraft. University of Michigan is conducting survey for state's Department of Aeronautics.



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Bendix Systems Division

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LETTERS

(Continued) →

Air Cushion Study

The letter concerns your article in the December 1987 issue of *Aviation Week & Space* for Vehicles in the Jan 12 issue (p. 74) of *Aviation Week*. I wish to take this opportunity to write your article as several disavowed developments of interest in the ground proximity effect with its smaller scale. I might add that Dr. Bousquet in his recent paper for the Academy of Helicopter Science had an excellent summary of the phenomenon applied to the field of ground supported vehicles.

I believe that in particular the work conducted by the NASA (not NASA) mentioned in your article requires explanation. The research at the Loma Research Center was initiated about June 1974 at which time a very small-scale model study was performed. The model used at that time, a delta in shape of NACA TN 1067. Because of the large scale used at that time design of a large scale setup was delayed until June 1975 and then was delayed starting in March 1976. The letter data is also reported in NACA TN 1013. This report was released in April 1977. Mr. H. K. Chapman's analysis of this study was published in July 1977. At his indication in his abstract, "The results are found to be in agreement with experimental data." That the ground proximity effect with its smaller scale was demonstrated first experimentally and then verified analytically. Your article as it is left paragraph explains the opposite.

The criticism pictures shown in NACA TN 1013 show that the pit is formed not wind flow but the ground, hence one of the problems in the analytical approaches by Victor Buckley and Chapman is to obtain an approximation of that pit shape in order to supply the data used in your article.

Prof. H. von Goertel, Chief
Phys. Physics Branch
Fluid Dynamics Division
National Aeronautics and
Space Administration
Loma Research Center
Chandler, Ohio

Super Regeneration

It is Dr. Dore of Bedford, C.M., in discussing what he called "highly life rate model" was in over his head when he wrote in his letter. But now that he is published even more in his second letter (*AV* Jan 17, p. 121) he is really compounded in problem.

It is evident that Dr. Dore in his letter has merged me into a life rate in light of my work for the Jan 12 issue. His approach, that most of his position was in an atmosphere of super regeneration. He's doing that so long in fact, that I think his standpoint has become mixed. His attitude, however, is not as excessive as it might seem at first glance. There are quite a few of these super-regeneration model builders who feel strongly that the common man who happens to be in the right place at the right time should most often be required to perform like a true

Aviation Week welcomes the opinions of its readers on the issues related to the magazine's editorial viewpoint. Address letters to the Editor, *Aviation Week*, 225 N. Third St., New York 36, N.Y. For no charge letters under 500 words will receive a prompt acknowledgment. We will not accept anonymous letters, but names of writers will be withheld on request, professional, or get out of the article. This is not of course a right profile issue of authors; it's a kind of me to overcome. If he stands there in no way, he will accept anonymous letters. There's no reason to let world his industry know his name for his name is known to accept such closeness in the ground, but I do think that he has himself a real problem in the air.

My Dr. Dore once again responds the others which is often discussed but never made to be. He has made it a story in a Supreme as the top. Nobody makes a more with an airplane until Super-regeneration the program more, now how could you do this and followed of the pilot jumping the more and then "then the equal." My Dr. Dore has been so thoroughly misinformed by his military experience that he can't conceive of any other way of being in the cockpit. The fact that the present FAA stands has several implications for such a pilot as evidence in the United States regarding a witness to Mr. Dore and his kind. We could only have to see one—and without much effort on his part, first—how the many millions of aircraft accidents that are being pilot today could possibly be handled in the summer he has suggested. My Dr. Dore, the FAA and look like a real chicken here.

My Dr. Dore, otherwise to what he calls "air discipline" and another way of discussing his own work on down wing out the entire U.S. civil aviation industry to me know it today. Can you imagine a forced airplane man, who has brought his \$10,000 private airplane being subjected to the kind of repression Mr. Dore apparently takes his guests? The way of this is to let the industry of the super-regeneration. A proposal like Mr. Dore's would eliminate a very substantial percentage of the \$100,000 salaries we have in our business every year. But he says it should! And if it were done, what do you think would happen to the automobile in America? And the highway building industry? And the passenger service industry? And the rate of the automobile?

It is quite true that the great majority of all accidents are "pilot caused," as Mr. Dore points out. That's because—just stating what the super-regeneration pilots pilots and up being more human beings. And the fact stands, at all times the FAA and Navy thousands, where these super-regeneration professional pilots, here in a two-wing test drive could such test, despite all the regulations. He then wonders. This letter has with only one comment: "Imagine that that accident rate would be without that regeneration?"

No matter what solution you design, you're short going to end up being trouble with

the human being involved. Still back in my mind is a sudden collision between two J-53's while circling in the traffic pattern of a West Coast Air Force base not long ago. I lost the transport many millions of dollars and lost a lot of lives—all unnecessarily. But of those accidents was the most experienced professional pilot that many remember the accident was the best the money can buy, and they were under the control of a traffic control system that looks nothing like yours.

Van President
Anthony Gennaro and Pilot Ann
Waldington, D.C.

Proper Solution

Barrett, if I had answers to and again of your magazine dated Nov. 10 and 17. Of particular interest is the Nov. 10 issue of "Cognitive Viewpoint" (p. 45). I imagine two or three as such a solution that I am forced to take violent exception to the 100% money contract theory. Unless Capt. Robison has closed his eyes to all the various circumstances concerning cockpit HTR, during the past few years, he must know that there is considerable opposition to a 100% HTR contract.

I could not as yet see even to imply that Capt. Robison is not to be given the right to "breakdown of the press." The only point to be made here is that only an enthusiastic journal to raise the public's eyes to the fact that there are as individuals as it is to make sure that they be so made. It is well known that all pilots and the military would prefer to have 100% HTR. It is also well known that the general business and private flying can be little as an individual as such a contract. I might also state the point that ground troops and private flying is in the more or more business in the air, and more money than the number of airplanes.

In your Nov. 17 issue about "Airline Observer" (p. 41) there is also an attempt to misrepresent something for the first time. In this case the ALPA, whose two most articles published by Capt. Robison, in response to the point that they have passed a resolution regarding legal action if necessary, to ensure that the agency charged with air traffic control responsibility will not adopt any procedure that could deny, through the use of airline company. The ALPA is quick to voice its feelings wherever it is not satisfied and it should understand that when representatives of the flying world say the same. At such a resolution was passed concerning cockpit operations, all of the ground forces and private flying pilots would have every right to meet on legal action concerning air rights.

It would appear that what is needed here is some common sense and common sense. Only in the way will we be a regulation increasing doing which will study all parties involved. I hope that your magazine will help lead the way toward a proper solution in these areas.

WILLIAM A. THOMAS, II
Pittsburgh, Pa.

THE MAN
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(Continued on page 61)



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